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Individuality in Industry

ATTENTION has frequently been directed in recent years to the growth of the professional spirit among those responsible for the control and organisation of industry, whether on its financial, commercial or technical side. Mr. C. H. Bailey was not therefore breaking fresh ground in stressing this point in a recent stimulating address to the Birmingham and District Association of the Institution of Civil Engineers. Already industry is being regarded as a public service—it is judged less by its capacity for earning profits than by the service it renders to the community to a much greater extent than formerly; Sir Josiah Stamp's reference to the service and profit motives in industry at the British Association meeting in Aberdeen was a warning against hasty conclusions as to the adequacy of the service motive alone, rather than a dissension from this view of the importance of industry.

The professional ideal of fitness for a purpose which is implicit in technology makes the professional contribution to industrial efficiency all-important in these days. In the address to which we have alluded, however, Mr. Bailey proceeded to show how professional institutions, in providing a standard of professional conduct and skill for those engaged in the technical direction of industry, cannot fail to be concerned with the changes in the structure of industry and society which are taking place through mechanisation. It is not merely that the professional spirit requires them to consider the type and size of the industrial unit or organisation which can serve most efficiently the needs of industry and the community. They must also consider such questions in relation to the well-being of members of their own profession and of society as a whole.

Loyalty to the highest professional ideals involves the consideration of these larger social questions. If machines, for example, can be used most efficiently, from the mechanical point of view, in large concentrations, the professional man must also consider the consequences of such concentration on individual incentives and initiative. If such concentration seriously limits the opportunities for the expression of individuality and destroys incentives by removing many of the opportunities for rising sooner rather than later to a position of free responsibility, the depressing effect on the quality of industrial recruits must

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soon or later be seriously reflected in the efficiency of the industry.

The gravity of the check to the mobility of industrial labour, which has been imposed alike by the mechanisation of industry and by changing educational conditions, is as yet not generally realised, although it has been emphasised in recent discussions on technical recruitment for the cotton industry. The importance of adequate incentives in large-scale industry was, however, a main theme in the important address delivered by M. H. Dubreuil before the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association; and it strongly supports the contention that the essential problem is to organise mechanical manufacture in such a way that it affords more men the opportunity of using their capacities to the fullest extent. Mr. Bailey's suggestion that industry should perhaps be organised more in small units in which more men could look forward to occupying positions of real responsibility, is not so much an attack on the size of industrial undertakings, or a pessimistic assertion of limits to the organising capacity of the human mind, as a reminder that, in the long run, industrial efficiency cannot be dissociated from social efficiency, and as such deserves careful consideration.

The problem of securing free play for individuality is as vital to industrial success as it is in scientific research or other activities. Without it, team work is apt to degenerate into something mechanical in which creative ability and original thought languish. Management, in fact, consists in taking care of the fundamental principles of organisation which implicitly respect the individual, and applying them to the purposes of the undertaking, and such principles have nothing to do with the size of the undertaking. J. M. Scott's tribute to Watkins's knack of making everyone a 'boss of something', and so allowing him to feel a personal glow of pride in every achievement, is not more an explanation of the success of an expedition of three men and a team of dogs in the heart of Labrador than it is the secret of successful management in the largest industrial organisations that exist.

M. Dubreuil's paper on autonomous groups in industry is of interest in this connexion, as indicating how wide a research field management still presents in just this matter of delegating responsibilities and associating the workers with the success of

the undertaking in which they are employed. In such research the professional spirit as well as scientific method must play its part, and while even from the narrowest professional point of view any institution such as the Institute of Chemistry or the Institution of Civil Engineers must recognise a real responsibility to its younger members to ensure that they have opportunities of utilising fully their ability, that responsibility is most wisely discharged when it is seen as part of the wider social and industrial responsibilities of the profession.

Discussions on the decline in the number of students attending technical courses of training for the cotton industry have once more emphasised the necessity for each great industry to consider both the quantity and the quality of its recruits. Unless an industry can make up its mind what numbers of recruits it needs, from what types and grades of schools or institutions they should be drawn, and in what proportion, and couples with this an adequate system of training and promotion, there is grave danger that the industry will find itself without a supply of recruits of the requisite calibre, or at least with such an insufficient supply that its efficiency is seriously affected and its power of expansion or recovery is impaired.

The extent of juvenile unemployment and the situation revealed by the reports on the depressed areas in the Midlands and North of England may easily engender a false confidence in industry at the present time. No industry can afford to recruit continuously, whether in its lower or its higher ranks, from those whose morale has been undermined by continuous exposure to intermittent or blind-alley employment and who are, in desperation, prepared to accept any situation which offers the prospect of steady work irrespective of their capacity. Nor can any industry ignore indefinitely the value of a planned policy of recruitment, training and promotion as a means of attaining the efficiency which enables it to hold its own in days of severe and unremitting international co-operation.

The question of industrial training and recruitment is thus one which is forced upon the attention of professional men in industry in many ways. Loyalty to their own junior colleagues demands its consideration. Their responsibilities as managers lead them to the study of new methods for securing the continuous co-operation of members of their staff and developing the morale and team spirit which are essential to efficiency and success.

Finally, the social responsibilities of industry demand the study of industrial structure and organisation, recruitment, location and planning of industries, so as to serve those general interests of the community with which ultimately the interests of industry are inseparably linked. It

is when these problems are approached from the point of view of life as a whole, and not merely of production, that the professional workers will succeed in making the contribution to industrial efficiency and social welfare which the community has a right to expect.

Reviews

Philosophy in the Garden

The Genetics of Garden Plants. By M. B. Crane and W. J. C. Lawrence. Pp. xvi+236. (London: Macmillan and Co., Ltd., 1934.) 10s. 6d. net.

THE occupation of gardening is both ancient and honourable, though it is only in comparatively recent times that those engaged in it have paid much attention to the origin of the material with which they work. Whether for utility, for medicinal use or for sheer beauty, European gardeners in older days were content to grow the plants that they found to hand, adding to them such new things as were brought in by the voyagers gradually exploring the world. To their enthusiasm and energy the works of the herbalists bear witness. But while these noble compilations were in progress a new era in horticulture was dawning. The discovery of the nature of sex in plants, initiated by Camerarius and so ably followed up by Kölreuter, led to the organised production of novelties through the method of hybridisation.

The great burst of work of this kind throughout the nineteenth century, so closely associated with the names of Knight, Herbert and Laxton in Great Britain, and of Louis Vilmorin in France, led to a vast enrichment of the flower and vegetable borders as well as of the orchard. Meanwhile, the philosopher had wandered out of his study into the garden. Developments so notable had begun to attract his attention, to challenge him to fit them into his scheme of things. The challenge was taken up, and philosophy's very considerable gift to the horticulturist was the second volume of Darwin's "Animals and Plants". The excellencies of the cultivated had arisen from the plebeian wild through the skilful selection of man. Philosophy applauded the solution, but what was selected, how it arose, and how it was perpetuated, philosophy was content to ignore.

Of all these things the gardener took little heed. He continued his usual practice, and the flow of newer and more beautiful things went on. Then came another philosopher who was also a gardener. Gregor Mendel disclosed the nature of heredity, and the disclosure gave more than a hint as to the

manner in which fresh variations arose. But Mendel's posthumous achievement was even greater. He forced the philosopher himself to become a gardener, and to this new combination William Bateson, its first great exemplar, gave the name geneticist. Then fortune felicitously intervened. John Innes, of the Manor House at Merton, died, bequeathing property and money for the furtherance of horticulture. The trustees, in appointing Bateson as director of the new institute, showed both foresight and courage, for there was not a little head-shaking over the matter in horticultural circles. To the third philosopher was given opportunity and a garden, and this book, dedicated to his memory by two of his old pupils and colleagues, sets forth the outcome from the horticultural point of view.

Following a brief introduction to Mendelian principles the volume is chiefly concerned with polyploidy and incompatibility, both phenomena of paramount importance to the horticulturist, in the elucidation of which the John Innes Institution has played a major part. With the establishment of the chromosome theory of heredity by the *Drosophila* workers in America, more and more attention was paid to the chromosome content of other forms of life, and it soon became apparent that many of the more marked horticultural varieties show marked differences in the number of their chromosomes, generally in the direction of increased number as compared with the wild or more primitive forms. Sometimes this increase is of the nature of simple doubling of the sets already present, as in the giant forms of the Chinese primula. In other cases, different sets of chromosomes were found to be 'superadded', leading to the formation of a new type of plant, self-fertile and breeding approximately true to type but sterile with the parent forms—in short, a new species. So arose *Primula kewensis* from *P. floribunda* and *P. verticillata*.

The possibilities inherent in polyploidy are enormous, and the complexities also are very great. Yet if the horticulturist is to understand his material and to continue to make headway he must have some acquaintance with the chromosomes and their vagaries, and nowhere will he find

a better introduction to this study than that which is here provided. It was a happy thought on the part of the authors to illustrate their teaching by an account, partly historical and partly analytical, of various flowering plants and vegetables. For each plant may differ in the course of its civilised progress. The sweet pea has progressed by means of simple gene mutations alone; to this the Chinese primula has added polyploidy, while into the garden dahlia has entered hybridisation also, and we would commend the section dealing with this plant as a résumé of one of the most beautiful pieces of analytical horticulture on record.

Fascinating as is the study of polyploidy in the flower border, it is of more practical importance in the orchard. Cox may be the perfect apple and Comice the perfect pear, but each has its short season and other drawbacks, and the localities are limited where they can be profitably grown. There is both room and need for many finer varieties than now exist. But, as earlier workers have found, breeding trees is a slow business and full of disappointments. Some of these in the past have been due to the existence of polyploidy among many of our best varieties, which were those naturally chosen to breed from. On this subject the authors offer many illuminating facts as well as a valuable discussion which should be most helpful in guiding future work.

The existence of polyploidy is not the only difficulty with which the breeder of new fruits has to reckon. Many varieties show what is termed 'incompatibility' with one another. The pollen of variety *A* may be perfectly good, yet unable to fertilise *B*, though with *C* it will cause the fruit to set. Careful and long-continued analysis at the John Innes Institution has shown that the many varieties of cherry fall into definite groups such that the members of a given group all show incompatibility with one another, yet at the same time their pollen can fertilise members of other groups and lead to fruit production. The existence of such groups—and they are found in other fruits besides cherries—is based upon definite genetical factors. Such knowledge is not only essential to the plant breeder, but is also most important to the grower when he comes to select varieties in the planning of his orchards. For where incompatibility is found, judicious inter-planting of different varieties is essential to good results.

As sound practical horticulturists, the authors have throughout kept the gardener in the forefront of their minds, and no gardener of imagination and intelligence can fail to be grateful for their clear and sympathetic exposition of the present state of knowledge in these matters. But as is fitting and inevitable, philosophy keeps

breaking through. Illuminating as this book must be for the trained gardener, we venture to think that it will be even more so for those who are sometimes termed 'pure scientists'. For in their analysis of garden plants the authors are continually shedding fresh light on the nature of species itself. It is clear that the manifestation of variety in the living thing is intimately bound up with the nature and arrangement of the chromosomes. About these little bodies much has already been learned through hybridisation and the systematic study of polyploidy. Recently, in X-rays the geneticist has found a new tool. He is already learning to produce new variations, though as yet the tool is far from being under control. Control, however, will come in due course, and with it perhaps the advent of the fourth philosopher.

Fossil Birds

Handbuch der Palaeornithologie. Von Prof. Kálmán Lambrecht. Pp. xix+1024+4 plates. (Berlin: Gebrüder Borntraeger, 1933.) 108 gold marks.

THE fossil remains of birds are usually only isolated bones. Even these are rare in most of the rocks which contain them, and those which have been collected are widely scattered among numerous museums. The few known bones of a Pliocene ostrich from Samos, for example, are in four museums in three different countries. We therefore welcome an exhaustive treatise on these fossils by Prof. K. Lambrecht, of Budapest, who has devoted many years to a study of the subject. He has not only prepared a critical summary of the literature, but has also examined the actual fossils in museums, and can thus write with first-hand knowledge. He has made many new observations, and he has also discovered important specimens which have hitherto been overlooked. His work is well illustrated with outline drawings and beautiful photographs, many of them original, and a few copied from published figures which are not readily accessible.

Prof. Lambrecht begins with a general account of the osteology of birds, accompanied by a series of good drawings which explain the various technical terms used in describing the bones. He then prefaces his systematic account of the fossil birds by a short historical introduction, which is illustrated by portraits of Richard Owen, A. Milne-Edwards and O. C. Marsh, who were pioneers in describing and interpreting the fragmentary specimens. He also briefly summarises his classification into orders, beginning with the Archaeopterygiformes and ending with the Passeriformes, without any grouping into larger divisions. He does not recognise the Odontornithes of Marsh,

but places the Cretaceous toothed birds close to the surviving orders to which he considers they are related.

The systematic descriptions are most exhaustive, with long bibliographies and numerous tables of distribution of the genera and species of the several orders. Some of the lists of the literature may perhaps be considered too exhaustive; even a story of Aepyornis Island by H. G. Wells, for example, is included. There are, however, many interesting novelties which enliven the technical compilation, such as the first photographs of the fragment which Marsh named *Laopteryx*, and drawings of the rudimentary wing bone of *Aepyornis*. There is also a useful stratigraphical and geographical list of genera and species.

A final chapter on the general palæontology and palæobiology of birds is remarkably comprehensive. Modes of fossilisation, feathers, footprints, eggs, gizzard stones, coprolites, guano and even nests are discussed. A fossilised nest from the Upper Miocene of Würtemberg, which is shown in a beautiful photograph, is especially noteworthy. Then follow remarks on the ways in which birds are adapted to their different surroundings and modes of life; and the concluding pages are devoted to the problems of evolution.

Prof. Lambrecht is indeed to be congratulated on having produced a handbook which is not only indispensable for all who study birds, but is also filled with matter of interest to every biologist.

A. S. W.

The Planet Mercury

La planète Mercure et la rotation des satellites: étude basée sur les résultats obtenus avec la grande lunette de l'Observatoire de Meudon. Par E.-M. Antoniadi. Pp. v+76+3 plates. (Paris: Gauthier-Villars, 1934.) 18 francs.

THIS little book does not belie the author's international reputation—the old adage, "Small bulk but guid gear", sums it up tersely, containing as it does matter to please and interest both the general reader and the serious student of astronomy. The monograph contains five chapters, namely: generalities; transits of Mercury; geography of Mercury or hermography, and rotation of the planet; atmosphere and mists of Mercury; the physical conditions of the planet; and a table of contents.

From the comprehensive opening summary of the oldest records with references, it is worthy of note that the early Egyptians, Chaldeans and Greeks recognised the identity of the evening and morning star. Again, the Egyptian priests, followed by the Pythagoreans and others, and much later, by Copernicus, discovered that Mercury, like

Venus, moved round the sun. Orbital elements and an explanatory diagram of the varying elongations are given together with the ancient names, evolution of symbols personifying quick motion, old and modern colour and brightness comparisons, Hevelius's discovery of the phases and that of their deficiency of Schroeter.

Transit records from 1631 until 1927, disc distortion at ingress and egress, light spots and the phenomenon of the complementary fringe around the black disc masking the extent of a Mercurian atmosphere are discussed.

The geography of Mercury, or hermography, and the rotation of the planet form the third and principal chapter—one of absorbing interest. Summarising the work of the past and present centuries, M. Antoniadi, authorised by M. Deslandres to make a systematic research on Mercury, describes his observations from 1924 until 1929 with the 0.83 metre (33.7-in.) refractor of the Meudon Observatory. His results and those of other observers agree generally with Schiaparelli's work both in the form and location of the surface features and the equality of the rotation period of 87.97 days with the revolution round the sun. A chart (Schiaparelli's is also reproduced for comparison) shows the light and dark markings appropriately christened from the Greco-Egyptian mythology of the great god Mercury. Generally, the observations show that: (1) the light areas are more extensive than the dark regions and show luminous spots as on Mars and the moon; (2) the visible portion of the southern hemisphere is darker than the northern as with the earth and Mars.

Libration, due to uniform angular rotation with variable orbital speed, illuminating 228° in longitude of the planet and leaving 132° in continual darkness, is explained. Tidal frictional force maintaining similar conditions on large satellites is also investigated.

Discussing the meteorology of the thin yet deep atmosphere of Mercury, with its shifting banks of suspended dust, the low albedo of 0.13 is inferred for reflection from a rough surface covered with broken rocks and dust.

That tin and lead would melt under a vertical sun reveals a very hot surface. A vivid—in part 'dramatic'—description of the state of Mercury makes no reference to radioactivity or to pressure of radiation. M. Antoniadi quotes Flammarion regarding life—"The forces of Nature produced different effects according to circumstances, and that all life cannot be excluded from Mercury"; again, in p. 69, the author admits the possibility of microbial life at the Mercurian poles. The reviewer agrees, and thinks that although the planets may not support *terrestrial* life, the

probability of cosmical life, of a form outwith our conception, might be envisaged.

A survey of the sky as seen from Mercury concludes the memoir, which is embellished by three plates and many fine drawings and diagrams.

H. McEWEN.

French Psychology

Nouveau traité de psychologie. Par Prof. Georges Dumas. Tome 2: *Les fondements de la vie mentale.* Pp. vi+612. Tome 3: *Les associations sensitivo-motrices; l'équilibre et l'orientation, l'expression des émotions, les mimiques, le langage.* Pp. vi+462. (Paris: Félix Alcan, 1932-1933.) 100 francs each.

THE French school of psychologists, led by Dumas and Piéron, have many important investigations to their credit. In their work, the refinement of detail is happily harmonised with those broad synthetic views which connote the classical character of the French mind. The collective treatise on psychology which will be completed in nine volumes, and of which vols. 2 and 3 are under review, is an outstanding result of team work relating to one of the most exacting of sciences. While the first volume, published some time ago, dealt mainly with questions of method, the second volume is devoted to the foundations of mental life. Here we find a detailed analysis of the relations between various kinds of stimuli and the reflexes, movements and secretions of the body; also of the sensitive and affective elements of mental life, such as the various types of sensations, pleasure and pain, emotions and tendencies; and finally of imagery and the relations between image and thought. All these questions are well treated by G. Dumas, H. Piéron, A. Mayer, B. Bourdon, J. Languier des Bancels and I. Meyerson. The study of the affective states (especially of emotion and of pleasure and pain) by Prof. G. Dumas and the monograph on images by I. Meyerson are remarkable examples of orderly exposition and unbiased discussion of results.

The third volume deals specifically with the major sensory-motor functions, such as orientation and bodily equilibrium, the expression of emotions, mimicry and language. Prof. Dumas rightly holds that no psychological functions are purely sensory or purely motor; though, of course, when analysing them one of these aspects may be stressed to the exclusion of the other. The study of vision, for example, which is generally considered as a purely sensory function, involves an important background of motor responses and muscular reflexes. The chapters on the expression of emotions are most interesting in their details, both in regard to the methods adopted and to the cases observed or

quoted. Attention, surprise, astonishment, joy, sadness, fear and anger are analysed not only as mere expressions of emotions, but also as results of physiological stimuli. Indeed what adds to the value of this volume is the fact that all experiments and observations are explained or discussed with due consideration of the physiological changes involved in each case. The two monographs by A. Ombredane on orientation and on language show the same qualities.

The value of the first three volumes of the "Nouveau Traité de Psychologie" causes one to await with eagerness the publication of the rest of this great work. It cannot be said that the French psychologists form a distinct and original school of thought. But their work is important precisely because of their detachment from any labelled group of scientific workers. Prof. Piéron might perhaps be counted as a behaviourist, since he was led by his animal studies to define psychology as the study of behaviour before Watson used that formula. But Prof. Piéron is more clear-headed than the American behaviourists, as Prof. Wordworth pertinently pointed out, for he sees no necessity for calling into question the individual's testimony to his own consciousness. Prof. Dumas, too, gives much weight to introspection. In spite of its difficulties, this method is really indispensable in psychology, since it has furnished the suggestion even for the objective studies that have been carried on, and since it supplies the personal interest which one finds in psychological results.

The main characteristics of French psychology, however, are its emphasis on the biological basis and the social setting of the individual's activities, and also its interest in psychopathology. These characteristics are very prominent in the volumes under review and enable their authors to steer a middle course among the growing complexities of psychological research. T. GREENWOOD.

Teaching of Elementary Physics

A Textbook of Physics. By E. Grimsehl. Edited by Prof. R. Tomaschek. Vol. 2: *Heat and Sound.* Pp. xi+312. 12s. 6d. net. Vol. 3: *Electricity and Magnetism.* Pp. xiv+685. 25s. net. Vol. 4: *Optics.* Pp. xii+301+17 plates. 15s. net. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1933.)

THE teaching of elementary physics in British schools and universities will be materially assisted by the appearance of these three volumes of Dr. Grimsehl's "Textbook". The high standard set in the first volume has been maintained throughout in the present volumes, and in certain respects the English edition may be said to be an improvement on the German original.

The translators have, on the whole, done their work well and have added useful explanatory notes whenever the original has appeared to be lacking in detail. In vol. 2, for example, Robert Mayer's calculation of the numerical relationship between work and heat from the difference of the specific heat of gases at constant pressure and constant volume is rightly criticised in a footnote which quotes from the works of Tait and Roberts.

Among the special subjects treated in this volume are atomic and molecular rays (Dunoyer), zero-point energy, and Nernst's heat theorem. In some cases the references are too brief to be considered useful, as on p. 277, where Behm's sonic depth-finder is mentioned without a suggestion as to how it works. The same applies to the electrical excitation of quartz crystals for producing ultra-sonic vibrations (p. 265), a subject on which much interesting information might have been compressed into a small space. The section on heat engines is clearly written and well illustrated. Not the least interesting feature is the great number of biographical notes scattered throughout these volumes. We read on p. 152 that K. F. Braun, who followed up and firmly established Le Châtelier's principle, was a professor at Strasbourg in the years preceding and during the Franco-Prussian War, and that in recognition of his valuable work in wireless telegraphy he shared the Nobel prize in physics with Marconi in 1909. He died in the United States, where he was staying at the outbreak of the European War and had been interned.

The section on waves is comprehensive; resonance and coupled oscillations are treated with great didactic skill. The last part deals with sound. Here the treatment of Kundt's tube experiment must be regarded as inadequate. But the blemishes are few, and the volume deserves a warm welcome.

Vol. 3 has been considerably revised and supplemented by Prof. Tomaschek as compared with the last edition issued by the original author. The result is in every way excellent. Many novel methods of treating electrical phenomena are given and it is gratifying to find that difficulties have not been shirked. For example, a simple but thoroughly useful account of the electron theory of metals is given and is afterwards applied to explaining the ultimate mechanism of electromagnetic induction. In a small section on "Waterfall and Thunderstorm Electrification" there is a quotation from Lenard that "no double layer is formed at the interface between water and air". The succeeding sentence runs: "on the contrary small droplets of diameter less than 10^{-6} cm. prove to be negatively charged when detached from the water surface". An examination of the context shows that "on the contrary" is misleading here

as a translation of the German word *hingegen*, which has only the strength of "however" on this occasion. For we know from Lenard's own work, as is mentioned on the next page, that an electrical double layer *is* actually formed at the surface of water but within itself. Attention may be directed to a slip in the index where a joule is given as equal to 10^7 dynes; it is given correctly, however, in the text.

As these books by Dr. Grimsehl make a point of furnishing biographical and historical details connected with important physical discoveries, it is surprising to find no mention of the earliest determinations of the elementary electric charge. Reference is made only to the work of Ehrenhaft and Millikan. This is a case where an illuminating note by the translator would have been welcomed. In some instances the account is rather meagre, for example, the treatment of potentiometers (p. 233) and of the ballistic galvanometer (p. 317); and occasionally we find that familiar English expressions have been omitted. English, and for the most part also foreign, students are accustomed to seeing the left- and right-hand rules linked with Fleming's name, and the theorem concerning the equivalent magnetic shell associated with Ampère. Nor is Townsend's name mentioned in connexion with ionisation by collision, a discovery of outstanding importance.

The chapter on high-frequency oscillation is very clear, but there is no mention of electrodeless discharges. Again, in dealing with thermionic valves, it would have been an advantage to introduce accepted English terms such as differential internal resistance, anode slope resistance and so forth. On p. 598 the Schottky-Langmuir formula deserves equal emphasis with that of Barkhausen.

Many readers will have been unacquainted with the Johnson-Rahbeck effect (p. 210) discovered in 1920, which makes it possible to use the force of attraction of a charged plate condenser in place of an electromagnet for mechanical action. The treatment of generators and motors is excellent and the accompanying diagrams exceptionally good.

This volume is perhaps the most stimulating of the four that have so far appeared. We may guess that the author is here dealing with his favourite subject. The way in which the material is presented confirms that Dr. Grimsehl's high reputation as a teacher was fully deserved. Vols. 2 and 3 have been translated by Dr. L. A. Woodward.

Little more need be said of vol. 4 than that it maintains the high standard of the preceding volumes of the series and that the illustrations are quite exceptionally good in many cases, as for example, plate VII facing p. 92, which shows the tracks of rays through thick lenses, and plate XII, which indicates how a cardioid condenser

(of the Siedentopf type) acts. Although a good plate (XIII, facing page 154) is given of spectra photographed by Gerlach and Schweitzer for deducing the composition of a mixture of tin and a small percentage of cadmium, no reference is made in the text to the diagram or to the fundamental principle underlying photographic spectrophotometry. There is a good section on autochrome photography but no account of ordinary photographic processes, or of the density curves of photographic plates. There is an interesting laboratory experiment devised by Dr. Grimsehl himself to explain the formation of rainbows.

Some of the less well-known effects of light are conveniently enumerated, such as the Weigert effect (action of polarised light on exposed photographic paper).

This volume, which has been translated by Winifred M. Deans, will be useful both as a textbook and as a reference book for those acquainted with only the elements of the subject. No doubt the last volume of the series (on atomic physics) will supplement the section dealing with spectral lines, so that the five volumes will constitute a complete elementary course in physics.

H. L. B.

Short Notices

Dipole Moments: a General Discussion. (Reprinted from the *Transactions of the Faraday Society*.) Pp. iv+677-904+lxxxvi. (London and Edinburgh: Gurney and Jackson, 1934.) 21s. net.

THIS reprint contains the account of the proceedings of the General Discussion held in April (see NATURE, 134, 802, May 26, 1934) together with an appendix consisting of a table of values of dipole moments for which Dr. N. V. Sidgwick and two collaborators are responsible. This appendix is a most valuable part of the report, since it contains not only the numerical values of the moments of a large number of substances, but also references to the original publications and such information as may be required in the interpretation of the data. The discussion dealt with the dielectric constant, the determination of dipole moments and the interpretation of dipole moments, and the papers contributed and the discussions on them are now available. The volume is one of considerable interest and value, and the Faraday Society is to be congratulated both on the success of the meeting at Oxford and also on the very material addition to knowledge which is represented by this volume. The type of binding of the reports has been improved.

The Surgery of the Sympathetic Nervous System. By Prof. George E. Gask and J. Paterson Ross. Pp. xii+163+13 plates. (London: Baillière, Tindall and Cox, 1934.) 16s.

THE surgery of the sympathetic nervous system is yet in its infancy. Our knowledge of this system itself is none too well developed, so that its surgery must of necessity remain in the experimental stage until our knowledge of the pathology is sounder.

The authors give us the results of their work in the surgical unit at St. Bartholomew's Hospital. The main body of the work is divided up into three divisions dealing with sympathectomy for disorders of (a) the circulation, (b) the visceral motor mechanism and for the relief of pain. Their results in some types of case which have been regarded as more or less intractable to treatment are surprisingly good, and we hope that the work, when fully developed, will yield results of even startling character.

Bilder zur qualitativen Mikroanalyse anorganischer Stoffe. Zusammengestellt von Prof. W. Geilmann. Pp. 12+40 plates. (Leipzig: Leopold Voss, 1934.) 8 gold marks.

THIS collection of 240 photomicrographs in 40 plates illustrates the forms of the particles of precipitates produced by analytical reagents. The reproductions are exceptionally good, and the forms of the crystals, the degrees of magnification and the conditions of precipitation are given, so that the results are free from ambiguity. The photomicrographic procedure is also briefly described.

Although the utility of microanalytical methods in a large field has undoubtedly been over-estimated by enthusiasts, they can play a very useful rôle in the confirmation of ordinary qualitative analysis in normal cases, and in cases where only a small quantity of material is available they become of increasing importance. Prof. Geilmann's book is very handy in size and contains practically all the cases met with in normal practice, so that it may be recommended as likely to find favour in analytical laboratories. It is convenient in size, as compared with some earlier publications in atlas-format, and will meet the requirements of all except the specialist in this field.

Materiewellen und Quantenmechanik: eine Einführung auf Grund der Theorien von de Broglie, Schrödinger, Heisenberg und Dirac. Von Prof. Dr. Arthur Haas. Vierte und Fünfte, verbesserte und abermals wesentlich vermehrte Auflage. Pp. viii+299. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 7.80 gold marks.

THE first German edition of this work and its English translation were reviewed in NATURE of March 9, 1929 (p. 362). Since that time it has been more than doubled in thickness by the addition of chapters on parahydrogen, Dirac's theory of the electron, the positron and applications of the Fermi statistics to metallic electrons. As before, stress is laid upon fundamental principles rather than detailed mathematical proofs, for which the reader is referred to the original sources, so that the book will appeal to anyone who desires an up-to-date and, within limits, a readable account of recent work in atomic physics.

Problems and Progress in Photography*

By OLAF BLOCH, Research Laboratory, Ilford, Ltd.

PHOTOGRAPHY is the recording angel of the arts and sciences, but it is to be hoped that angels of other classifications do not have to endure the insistent requests for materials possessing incompatible properties which are demanded of the photographic chemist. Perhaps the most difficult problems are presented by the physicists and astronomers, who require grainless emulsions of extremely high speed, sensitive to all the visible spectrum, or any portion of it—with extensions into the ultra-violet and infra-red regions!

For work in the neighbourhood of the $H\alpha$ line, two types of emulsion are now available, one which attempts to give the astronomers a maximum sensitivity at $\lambda 6500$, and another, which has fairly even sensitivity round this region of the spectrum, extends well beyond. The spectrum of meteors has been successfully photographed by Williams, of the Steward Observatory, and for this purpose an emulsion of great speed and high green sensitivity was necessary. Other recent emulsions include one with a maximum at $\lambda 5300$ for work on the solar corona, and another, for lunar disc photography, of fine grain and high contrast, where an attempt has been made to compensate for the low speed by extreme colour sensitising.

In the region of atomic physics, properties of another kind are desirable. For α -particle and proton track work, it is essential that the grain of the emulsion should be fine, resolving power high, and that the unexposed portions should yield but few or no silver grains upon development. Normally, emulsions have about 3.5×10^6 such grains per cm.^2 when developed without exposure, the average size of these being dependent upon the size of the silver halide crystals; but a recent product of the emulsion maker's art gives almost complete freedom from these.

Quite different requirements are necessary for work with atomic rays and in the extreme ultra-violet. Here the radiation has little penetrating power and is readily absorbed by gelatine. Hence, only sufficient gelatine must be used to bind the silver halide, or the crystals of the latter must be made to project beyond the gelatine surface—a rock-garden effect! The Schumann plates, always somewhat untrustworthy, are of the former type, and recently an emulsion of the latter kind has been produced which appears to be sturdier and more constant in its properties.

There are two main sections in photography:

first, its applications, including the important function of recording; and secondly, the internal problems of the subject, dealing largely with the mechanism of emulsion making and the effect of light upon the sensitised silver halide. The function of gelatine in emulsion making is complex: first, it holds silver halide in suspension, a suspension by no means perfect, since sedimentation usually takes place when the liquid emulsion is allowed to stand. Secondly, it is the principal means by which speed can be obtained; and thirdly, it prevents too rapid reduction of the unexposed silver halide in the developer, whilst permitting a sufficiently slow reduction of the latent image to enable control to be exercised. The amount of gelatine necessary to produce suspension is very small, so little as 1 gm. of gelatine per 100 gm. of silver halide being effective. Discussion is still rife as to the mechanism of the silver halide gelatine system, one argument being that bodies in the gelatine, having the iminazole and azine linkages, tend to form adsorbed layers of the protective colloid on the silver halide surfaces. It has not been found possible to remove the gelatine entirely from the latter by centrifuging and subsequent washing, and whether the retention of the gelatine is mechanical or otherwise, it would probably not be without effect upon the resulting emulsion.

The silver halides are all light-sensitive and darken when exposed to light, free halogen and metallic silver being amongst the reaction products when the intensity is sufficiently high, but exceedingly low intensities suffice to produce a developable latent image when the emulsion is in a highly sensitive condition. Very little is known about the changes which occur in these circumstances. It is at present generally held that the first action of light is the splitting off of electrons from the bromine ions in the silver bromide, with the consequent discharge of silver ions forming atoms of free halogen and free silver, the emulsion possibly becoming developable by reason of the altered position of the electric charges. The photo-electric effect does not appear to play a part, but it has been found that the photo-conductance of silver bromide in exceedingly thin layers increases and decreases in a manner corresponding to its spectral sensitivity in energy terms, the photo-sensitive units probably being the bromide ions. Also, in the case of a photo-voltaic cell consisting of electrodes of silver bromide coated on silver and in a bromide solution, the illumination of one pole sets up potential differences. In most of this

* Substance of three lectures delivered at the Royal Institution on October 30, November 6 and 13, 1934.

work the suggestions are purely theoretical, or have resulted from experiments on precipitated or deposited silver bromide *per se*, or of silver bromide crystals in an isolated condition. Little of the work deals with the silver halide in its actual emulsion form. Such evidence as can be obtained depends almost entirely upon the action of a reducer in order to study the effect of light in producing the latent image, and we have very little real knowledge of the state of affairs existing in the silver halide crystal in emulsion form either before or after exposure. The conclusions reached at present are largely inferential and this remains one of the unsolved problems of photography. Also, we have no exact knowledge as to the relationship between light quanta and latent image.

acts by deforming the ultimate structure of the silver bromide, thus affecting the silver and bromine ions, so that the photo-chemical decomposition might be more localised with a more ready splitting off of the bromine electrons. There is no doubt of the main facts, but it seems probable that it is only a particular case, since other substances not containing sulphur can act similarly, though less effectively, in the case of the desensitised gelatines.

A great deal has been done in the investigation of the phenomenon of development, and, in general, two views may be said to hold the field: one is that the reduced silver is dissolved in the developer and re-deposited; the other formulates the idea that the reducing

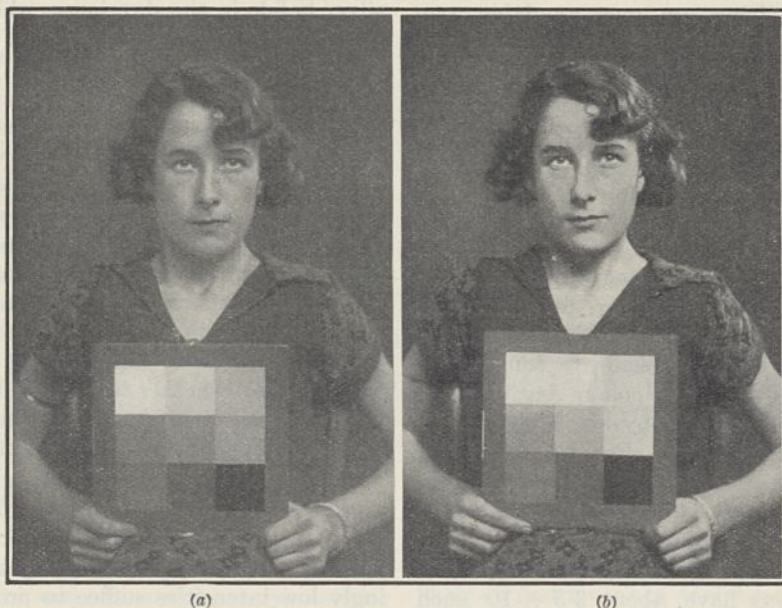


FIG. 1. (a) Negative made on the unexposed portion of the characteristic curve of an emulsion and developed for a long time to secure maximum contrast. (b) Negative made on the straight line portion of the characteristic curve of the same emulsion and developed for a short time to secure minimum contrast.

One of the interesting discoveries was the existence of minute quantities of sulphur compounds of the thiocarbamide type in gelatine. When the gelatine was sufficiently purified to remove these, emulsions prepared with it were of low sensitivity, and the restoration of the sulphur-containing compound, at almost any stage of the emulsion making process, restored the sensitivity. In practice, the original sensitivity cannot be greatly exceeded by increasing additions of the sulphur compound beyond a certain point, since fog results. There would appear to be an adsorption of the sulphur compound on to the silver halide, subsequent reaction yielding silver sulphide in the form of specks which are supposed to be the sensitive nuclei.

Much work has been done upon this subject, and it has been supposed that the silver sulphide

ions of the developer are first adsorbed on to the silver, a re-arrangement afterwards occurring which gives metallic silver and oxidised reducer. The function of gelatine as a protective agent in reduction is not complete since all emulsions show some reduction if the reducer is allowed to act for a sufficiently long period.

The mode of expression of the speed of an emulsion is still a vexed question, since it is impossible that one figure can express a variety of different properties in any one substance. Speed may depend upon the portion of the emulsion curve which is employed for the particular purpose in hand (Fig. 1, *a* and *b*), and a knowledge of speed alone need by no means be the first consideration—gradation, resolving power, graininess and other properties may be of equal or greater importance.

The older Hurter and Driffeld method of expressing the speed depends upon the straight line portion of the characteristic curve, and this is a measure of the contrast (γ) of the emulsion as well as of its speed, and is often inadequate. More modern methods, including the German DIN (*das ist normal*) system, depend upon some function of the under-exposure curve and yield a speed number which is, perhaps, more in accord with the requirements of those who take instantaneous camera pictures. There are many obstacles in the way of giving a brief statement as to the properties of any one photographic emulsion, the variation in the gradation and length of both the under-exposure and the straight line portion of the curve, the shape of the over-exposure curve and the exposure point at which it begins to function, the failure of the emulsion to obey the reciprocity

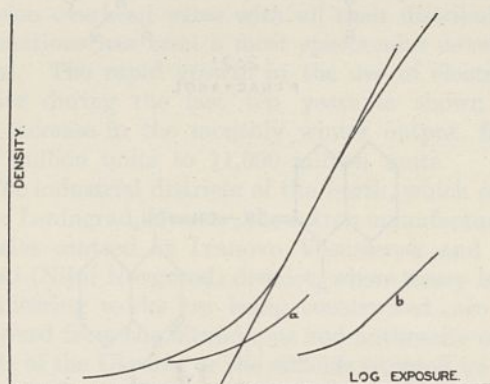


FIG. 2. Characteristic curve of the emulsion used in Fig. 1. Portion used in Fig. 1a is marked a; that used in Fig. 1b is marked b.

law, may all enter into one or other of the uses to which the sensitive material is to be put. It is certainly important that some indication of the photographic quality of the material used should be given, but it is not possible to accomplish this satisfactorily until a much larger proportion of the camera-using public is educated to a higher photographic standard.

Two important properties of emulsions are resolving power and graininess. The former is a very complex quality, depending upon a large number of factors. It has been defined as the capacity of an emulsion to resolve a number of lines and spaces per millimetre, the lines and spaces being of equal dimensions. Some of the factors influencing it are the maximum contrast obtainable and the shape of the characteristic curve, the amount of scatter due to the film, its graininess, its spectral sensitivity, the size of the image, etc. Other factors are shape, range of contrast and spectral quality of the object, the amount of exposure, the treatment in processing,

the aperture of the lens and the spectral quality of the light used for taking the photograph. Some of these operate in antagonistic directions: for example, resolving power decreases with grain size, but since emulsions of very small grain size are somewhat slow, their use is impracticable where high speed is required. In the same way, small lens apertures are not possible in the same circumstances.

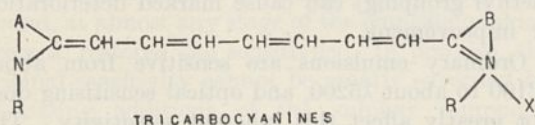
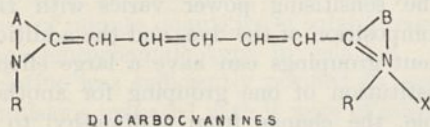
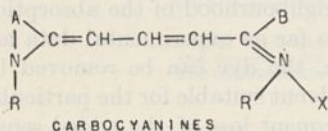
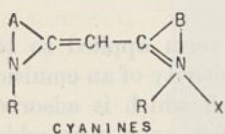
It is necessary, for many purposes, to enlarge the photographic image; for this reason, the cinematograph and the increasing use of the small precision camera have made the question of graininess an important one. Graininess might be defined as the distance at which the image of the silver deposit no longer appears uniform at constant magnification, or the magnification at which the silver deposit no longer appears uniform viewed from a constant distance. The question is a physiological one and a standard is therefore difficult to set up. Various methods, mostly visual, and chiefly comparative in character, are used for determining this property. Graininess depends mainly upon the emulsion itself, factors being the size of the original silver halide crystals and the extent to which clumping occurs, either in the emulsion itself, or as a result of development. Modern emulsion making has shown considerable advances in the direction of producing faster emulsions possessing a relatively fine grain, and it seems probable that these methods can be still further developed.

Optical sensitising is the term applied to the alteration of the spectral sensitivity of an emulsion by the addition of a dyestuff which is adsorbed by the silver halide and confers upon it an added sensitivity in the neighbourhood of the absorption of the dyestuff. So far as experimental data are at present available, the dye can be removed by the use of an inert solvent suitable for the particular dyestuff, with consequent loss of the added sensitivity. The sensitising power varies with the chemical composition of the dye, and the addition of substituent groupings can have a large effect, or the substitution of one grouping for another (for example, the change from a dimethyl to a diethyl grouping) can cause marked deterioration or improvement.

Ordinary emulsions are sensitive from about $\lambda 2100$ to about $\lambda 5200$, and optical sensitising does not greatly affect this inherent sensitivity. The amount of dye needed for optimal sensitising can be extremely small; in the case of one dye, for example, it is of the order of 1 gm. molecule of the dyestuff to 357,000 gm. molecules of silver bromide. In another case, at the other end of the scale, it is as large as 1 gm. molecule of the dyestuff to 6000 gm. molecules of silver bromide.

The smaller grains of the emulsion adsorb more dye than the larger, possibly owing to their greater area per unit mass, and this accounts for the higher contrast obtained when exposure is made to light of a longer wave-length than that to which the emulsion was originally sensitive, since the smaller grains give steeper gradation than the larger and become more highly sensitive in consequence of the increased dye absorption.

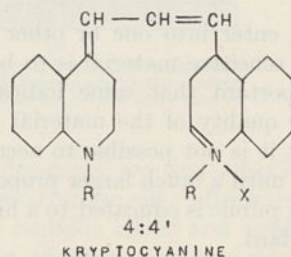
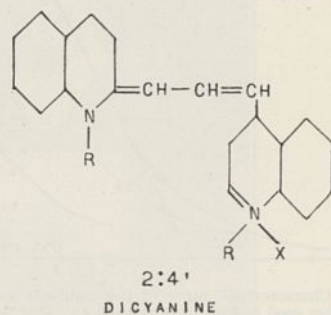
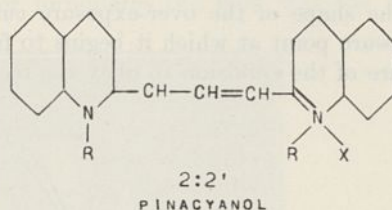
Bancroft, Sheppard and many others have put forward a number of theories to account for the phenomenon of colour sensitising, and we have still almost everything to learn about its mechanism, but a good deal of recent work is likely to go far to clear up the chemistry of the dyestuffs employed. We can classify these into a number of chemical groups, and can generally say which particular compounds are likely to sensitise and which are not, from a consideration of their constitution; we can forecast with fair accuracy the region over which they are going to sensitise the emulsion, and in some cases foretell whether they will be weak or powerful sensitisers. In the older days, erythrosine was almost the only dye used, and sensitised the emulsion up to about $\lambda 5800$, but with the advent of the cyanine group of dyestuffs, great progress has been made and it is now possible to sensitise an emulsion, at will, to almost any part of the visible spectrum. This class may be thus represented:



A and *B* represent several types of nuclei and the compound may be unsymmetrical when *A* and *B* are different nuclei. The number of CH groups is odd. *R* may be methyl, ethyl, allyl, etc., and *X* may be chloride, bromide, iodide, *p*-toluene sulphonate, etc. Substitution may also take place

in the chain, where one of the CH groups may be replaced by an alkyl, aryl, ethylene or phenylene group, or there may even be a halogen substituent in the chain. Generally speaking, as one increases the chain length, the dye becomes more unstable and the photographic products prepared with it more unstable. As the length of the chain is increased, the dye absorption and sensitising power travel towards the red end of the spectrum, each additional pair of CH groups moving the absorption by about 1100 Å. towards the red end of the spectrum.

The case of the three carbocyanines with the following formulæ is of interest:



The sensitising chain is from the nitrogen in one nucleus to the nitrogen in the second nucleus. Hence, the three isomers, the 2:2', the 2:4' and the 4:4' compounds, sensitise progressively farther into the red.

Many photographic research laboratories are actively at work on the production of new sensitising dyestuffs, since the use of colour sensitive emulsions is varied and important. Competition in the photographic industry is very keen and considerable progress has been made in recent years, but in many branches empiricism is still much in advance of proven theory.

Electrical Developments in the Soviet Union

THE growth in the use of electrical energy in the Soviet Union in connexion with the Government's industrial development schemes were outlined in a paper read to the Institution of Electrical Engineers by Mr. Allan Monkhouse on January 10. He gave interesting details also of the development in the use of peat fuel in large power stations. The first State-planning organisation set up by the Government was the State commission for the electrification of Russia appointed in 1921. In forming this commission, Lenin emphasised the necessity of providing an abundant supply of cheap electrical power as a basis on which industry could develop. From 1923 onwards the construction of fifty-six large power stations and the erection of 8,000 miles of high-tension overhead wires with all their distributing substations has been a most spectacular development. The rapid growth in the use of electrical power during the last ten years is shown by the increase in the monthly winter output, from 750 million units to 11,000 million units.

The industrial districts of the north, which comprise Leningrad, Moscow, the cotton manufacturing district centred at Ivanovo Vosnesensk and the Gorki (Nijni Novgorod) district, where many large engineering works are being constructed, are far removed from the bituminous and anthracite coal-fields of the Ukraine or the oilfields situated on the shores of the Caspian Sea. For economic and strategic reasons, it was considered necessary to make the northern industrial areas independent of these fuel supplies. Special attention was therefore concentrated on the development of stations burning peat and brown coal.

A survey of the peat areas of the U.S.S.R. indicates that approximately 42 per cent of the world's peat resources are located in that country. It is calculated that 30,460 million tons of fuel are available south of lat. 60° N. North of this line, the vast peat resources of the tundra have as yet only been partially surveyed. Using a special form of shaft-chain grate, it was found that the efficiency obtained was quite satisfactory. The Balakna power station in the Nijni Novgorod district is the largest peat-burning power station in the world. Its present capacity of 158,000 kw. is being increased to 204,000 kw. Of the eighty-one official stations, approximately 30 per cent operate on peat fuel. A special process of peat-winning known as the hydro-peat process has been developed. The peat is dislodged from the bog with a high-pressure sluicing apparatus, and the mixture of peat and water is then pumped into specially prepared drying fields. After a few days'

drying, a special form of tractor with cutter wheels is driven over the field and leaves the peat in such a form that it can be raked up easily and finally air-dried. The shortcomings found initially in using peat in a power station have been in large measure overcome, mainly by experimental research.

In the Ukraine and the mining districts of the Don basin, much work has been done in utilising the anthracite-waste spoil-banks, which have accumulated over a period of many years, but the efficiencies obtained have been rather disappointing.

Large areas of the cities of Moscow and Leningrad are already heated with hot water circulated from the central power stations. On the outskirts of these cities, large new so-called thermal-electric stations are being built for heating the new residential districts. In Moscow the hot water leaves the water-heating plant in the central power station at a temperature, varying according to conditions, of between 85° and 120° C., and after making a circuit of some two miles, it returns at a temperature of 30°–35° C. The pipes are laid in special conduits in the street and are covered with thermal insulation. Many of the large new industrial towns are being built with the idea of all their buildings being heated from central thermal-electric power stations.

With the exception of the Ural Mountains and the Caucasus, both of which are far removed from the central industrial areas, there is not enough mountainous country to make high-head hydro-electric power stations possible. But the Soviet Government has decided to build a series of large low-head hydro-electric stations on the great rivers of European Russia. The dam built on the Dnieper and those being built on the Volga and the Svir have a twofold object in view, namely, providing cheap electric power and making the rivers navigable for large vessels. Of the low-head stations, that on the Dnieper is the most important. The pressure of transmission is 161 kilovolts, and the station supplies the works of the Dnieper Combine and the central Ukrainian network.

A most important undertaking in Central Asia is the Chirchick fertiliser works, designed to produce large quantities of nitrate fertiliser for the cotton fields of Central Asia. The first station has been begun and the turbines will work with a head of 66 metres. The scheme provides for irrigating 1,250,000 acres of cotton growing land. It is interesting to notice that the Soviet authorities have called in Italian consulting engineers to lay out the hydro-electric part of this great scheme.

Some progress has been made in standardising

methods. The line linking the new Svir hydro-electric station with Leningrad uses the very high voltage of 220 kilovolts. The Soviet intends to electrify about 2,300 miles of railway before 1937. The pressure of 1,500 volt direct current is generally used for suburban electrification, but the voltage for the long distance main lines has not yet been fixed.

Mr. Monkhouse laid stress on the extreme importance the Soviet authorities attach to research and experimental work. Academic and fundamental research work is receiving the closest

attention, and very large electrical research laboratories have been developed. All the various works and factories connected with the Electro-technical Trust send their more complicated problems to the Central Institute in Moscow. The laboratories employ 1,700 workers, about 800 of whom are men with university training. The departmental chiefs are, almost without exception, men who occupy professorial chairs in the universities. There is little doubt that, in electrical development, more has been achieved than in many other branches of the country's economic life.

News and Views

"Letters to the Editor"

ON two occasions last year, issues of NATURE were published in which "Letters to the Editor" occupied considerably more than the usual proportion of the journal. This week we are printing a Supplement of sixteen pages, fifteen of which are occupied by correspondence—and there are still many letters in type awaiting publication. The number of letters we receive for this part of the journal reflects fairly accurately, we believe, contemporary progress of research in all departments of science. Last year we printed no less than 597 columns of correspondence, the great majority of which announced new lines of work or made significant contributions to older established knowledge. The addresses at the ends of the letters in this week's Supplement alone indicate the world-wide distribution of our correspondents. The spate of letters brings its own difficulties, and we are frequently obliged to ask correspondents to reduce the length of communications, but nevertheless we are gratified to find our columns so much in demand. It reaffirms the old saying that science over-rides all national barriers. Recently, a short section has been introduced at the end of "Letters to the Editor", in which brief mention is made of points brought out in some of the longer letters in the preceding pages. Correspondents will realise the difficulties involved in obtaining suitable notes, and they are invited to submit paragraphs about fifty words in length which they regard as summarising the main conclusions of their communications, for possible use in this section of the journal when their letters appear.

Royal Astronomical Society's Medal Awards

THE Gold Medal of the Royal Astronomical Society has been awarded to Prof. E. A. Milne, Rouse Ball professor of mathematics, University of Oxford, for his work on radiative equilibrium and theory of stellar atmospheres. A Jackson Gwilt (bronze) Medal has been awarded to Mr. Walter Frederick Gale, of Waverley, N.S.W., for his discoveries of comets and his work for astronomy in New South Wales. Prof. Milne has occupied his present chair since 1929, having then moved to Oxford from Manchester, where he had been professor of applied mathematics.

Before going to Manchester, however, he was university lecturer in astrophysics at Cambridge and assistant director of the Solar Physics Observatory. His contributions to mathematical physics and astrophysics are of particular value on account of the close contacts they represent between observational work and theoretical conceptions. His essay as Smith's prizeman at Cambridge in 1922 embodied a treatment of radiative equilibrium which has proved the starting point for the greater part of the more recent work on stellar atmospheres. In his Bakerian lecture of the Royal Society in 1929, on the opacity of stellar atmospheres, Prof. Milne further developed a method of determining stellar temperatures and pressures, depending largely on the study of the contours of spectrum lines, that is, on the determination of their intensities at different distances from the centre of the lines. Of a different character is the model of the universe conceived by Prof. Milne and developed in a lecture entitled "World-Gravitation by Kinematic Methods" delivered before the London Mathematical Society in May last. The striking simplicity of the method used in the construction of this statistical model, and the far-reaching character of its interpretations, open up a new vista of possibilities for cosmic research.

MR. GALE, the Jackson Gwilt medallist of the Royal Astronomical Society, belongs to the enthusiastic band of non-professional, or amateur, astronomers who have contributed so much to observational astronomy. He is the discoverer of three comets—in 1894, 1912 and 1927—and has given close attention to the planet Mars, especially during the southern oppositions of 1892, 1894 and 1907. As first secretary, and afterwards president, of the New South Wales branch of the British Astronomical Association, Mr. Gale has done much to encourage the practical study of the heavens in New South Wales, as well as to promote interest in astronomy among the general public.

Geological Society's Awards

THE Geological Society of London has this year made the following awards: Wollaston Medal to

(Continued on p. 111.)



No. 115. January, 1935

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SCIENCE PROGRESS

In the scientific library *Science Progress* may claim a place second only to that of *Nature* itself. It records in a readable and easily assimilable form the main trends of thought and the new achievements in all branches of science. The aim of its editorial policy is that each article shall appeal to readers who are not specialists in its particular subject. Each number contains at least one article by a leading scientist, describing work with which he has been identified, and the papers are illustrated where necessary.

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- Clouds in the Sky and in the Laboratory**
 PROF. SIR GILBERT WALKER, F.R.S.
- The Corrosion of Metals** DR. U. R. EVANS
- Soil Structure in Relation to Vegetation**
 PROF. E. J. SALISBURY, F.R.S.
- Electron Optics** DR. L. C. MARTIN
- The Prevention of Mine Explosions**
 DR. J. W. WHITAKER
- The Indian Lac Industry** T. HEDLEY BARRY, F.I.C.
- New Ideas in Modern Physics** DR. L. F. BATES
- Recent Advances in Science**
 Astronomy—Pure Mathematics—Physics—General,
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 Botany—Entomology—Archæology

Notes

Soil Microbiology in the U.S.S.R.—Antimony as a Poison—Scottish Meeting of the International Pre-Cambrian Association—Longitude Observations in Jan Mayen and Continental Drift—The History of Science—Miscellanea

Essay Reviews

- The Limitations of General Relativity (Prof. E. A. Milne, F.R.S.)
- The Relationship of Genetics to Medicine (Dr. P. A. Gorer)

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Supplement to NATURE

No. 3403

JANUARY 19, 1935

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 110.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

α - β Intramolecular Transformation of Myosin

SHORTLY after the discovery and investigation by the methods of X-ray analysis¹ of the long-range elastic, intramolecular transformation which takes place when the fibre-substance (keratin) of hair is stretched, the possibility emerged that the elastic mechanism of muscle is similar at least in principle to that of hair². There is a remarkable likeness between the X-ray photograph of washed and dried muscle and that of unstretched hair (α -keratin), and there are, moreover, certain striking analogies between their respective elastic properties. Recently, the X-ray and elastic comparison between muscle and hair has been set out in detail³, and once more the suggestion was made that the normal molecular configuration of the muscle protein myosin—first shown by Boehm and Weber⁴ to give, when oriented, an X-ray photograph resembling* that of muscle itself—is that of a folded polypeptide chain system like that of α -keratin, which it should be possible, by extension under appropriate conditions, to transform into a fully-extended system like that of β -keratin (stretched hair). The present writers tried to bring about this transformation two years ago by experiments on the sartorius muscle of the frog, but without success⁵.

We have succeeded now in demonstrating the predicted intramolecular transformation by working with the isolated muscle protein instead of with the actual muscle. We have found air-dried myosin films to have the following properties: (1) as in gelatin films, the molecular chains lie roughly parallel to the surface; (2) on moistening with water and stretching, these chains are first pulled into approximate parallelism with the direction of stretching and give rise to an X-ray photograph resembling that of muscle or α -keratin; (3) on further stretching, a new photograph appears which closely resembles that of β -keratin; (4) on exposing the stretched film for a few seconds to steam, the β -photograph is 'set' and intensified at the expense of the α -, exactly as in the case of stretched hair; (5) myosin films can generally be stretched in cold water to about three times their original length and, like keratin fibres, show well-marked long-range reversible elasticity, the β -photograph disappearing again on contraction provided the film has not been kept stretched in the dry state; (6) when myosin films are made by squeezing the re-moistened protein between glass plates, the

* Boehm and Weber claim that the two photographs are indistinguishable, but this is at least doubtful until much more perfect photographs are available. It may be said with equal justification that the photograph of hair is also almost the same as that of myosin.

β -photograph is again observed, but this time with the 'side-chain spacing' normal and the 'backbone spacing' parallel to the flat surface, just as when keratin is squeezed laterally in the presence of steam⁶; (7) *unstretched* myosin film, when exposed for a few minutes to steam, contracts spontaneously by about 20 per cent (artificial muscle!), exactly as does keratin that has been brought into the labile state by the action of X-rays on the α -form or by the limited action of steam on the β -form⁸.

In brief, myosin films are amazingly similar to the labile, or super-contracting, form of keratin which is produced by the breakdown or modification of certain cross-linkages; and in this comparison the normal contraction of muscle corresponds to the super-contraction of hair². Only very imperfect chemical analyses of myosin and muscle are available—and here the physicist is in very urgent need of help—but, *if we except cystine*, the general distribution of amino-acid types appears to be similar to what has been found for keratin. Does this mean that the method of formation of hair is fundamentally similar to that of muscle, except that the elastic system of hair is more or less stabilised and de-sensitised by the incorporation of relatively large amounts of cystine? In other words, are we to conclude that the hair protein is roughly speaking no other than 'vulcanised' muscle protein?

The investigation is being continued in order to try to find out the exact relations between the X-ray photographs and elastic properties of muscle, myosin, and keratin. We wish to express our indebtedness to the Rockefeller Foundation for financing the research, to the superintendent of the Cambridge Low Temperature Research Station for his kind co-operation, and to Dr. E. C. Smith of that laboratory for the invaluable supplies of fresh myosin which have so far formed our exclusive experimental material⁷.

W. T. ASTBURY.
SYLVIA DICKINSON.

Textile Physics Laboratory,
University of Leeds.
Jan. 7.

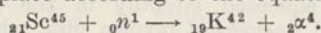
¹ W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75; 1931. W. T. Astbury and H. J. Woods, *NATURE*, **126**, 913; 1930. *Phil. Trans.*, A, **232**, 333; 1933.

² W. T. Astbury, *Trans. Faraday Soc.*, **29**, 193; 1933.
³ W. T. Astbury, "X-Ray Studies of Protein Structure", Cold Spring Harbor Symposia on Quantitative Biology, **2**, 15; 1934; and "Röntgenoskopie von Proteinfasern", *Koll. Z.*, **69**, 340; 1934.

⁴ G. Boehm and H. H. Weber, *Koll. Z.*, **61**, 269; 1932.
⁵ W. T. Astbury and W. A. Sisson, *Roy. Soc.*—in press.
⁶ W. T. Astbury and H. J. Woods, *Phil. Trans. Roy. Soc.*, A, **232**, 333; 1933. H. J. Woods, *NATURE*, **132**, 709; 1933.
⁷ E. C. Smith, *Proc. Roy. Soc.*, B, **105**, 579; 1930. **114**, 494; 1934.

Natural and Artificial Radioactivity of Potassium

THE question of the origin of the radioactivity of potassium has been much discussed in recent years¹. The possibility, however, of producing new radioactive isotopes artificially has opened up a new line of attack on this problem. Quite recently Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti and Segrè² have found that, by bombardment of potassium with neutrons, a new radioactive isotope of potassium is produced having a period of 16 hours. Potassium having two stable isotopes, 39 and 41, it is not possible to draw conclusions from these experiments on the mass of the new isotope. The problem can be settled, however, from the fact that the new isotope of potassium can also be produced by bombarding scandium with neutrons. By experiments in this laboratory in which I have been kindly assisted by Hr. Høffer-Jensen, we find that scandium can be converted into a radioactive isotope of potassium. As scandium has only one isotope (45) this conversion must take place according to the equation:



As the potassium obtained by us has the same period as that found by the Italian workers, we have to conclude that in their experiments it was K^{41} which captured a neutron and was converted into K^{42} . In our experiments we bombarded scandium oxide with neutrons produced by a mixture of beryllium and radium emanation, thus applying Fermi's beautiful method. The scandium oxide was dissolved in hydrochloric acid and, after the addition of 0.15 gm. of sodium chloride and the same amount of calcium chloride, precipitated with ammonia. The calcium present in the filtrate was removed as oxalate and found to be inactive. The remaining sodium chloride, however, was found to be active and to contain the potassium isotopes looked for. This decayed with a period of about 16 hours, emitting very hard β -rays of approximately 1.2 million e.v.

From my comparison of the radioactivity and the atomic weight of potassium fractions obtained by distillation processes (partial separation of isotopes), it follows that the mass of the isotope to which the natural radioactivity of potassium is due can only be 40, 41 or 42. The first mentioned figure is obtained if we accept Baxter's analysis of the fractions, while that of Hönigschmid is only compatible with 41 and 42. Knowing now that the isotope 42 has a short life (16 hours) we are restricted to the alternative 40 or 41.

From measurements with the mass-spectrograph, we know that K^{41} is present in potassium in the extent of 7 per cent. From this figure and the number of β -particles emitted per second by 1 gm. of potassium, it follows that, if the natural radioactivity of potassium is due to K^{41} , it has a period of 10^{12} years. The hypothetical isotope K^{40} should have a much shorter life as this isotope has not been revealed by measurements by the mass-spectrograph. From this fact the upper limit of its period can be stated to be 5×10^{10} years. A lower limit, 10^8 years, is given by the calcium content, potassium content and geological age of old minerals. Presumably when potassium is bombarded by neutrons, K^{39} captures neutrons as well, but since the resulting K^{40} has a long life, its formation cannot be established through measurements of induced activity.

The great difficulty for the theory of β -ray emission, arising from the fact that potassium, in spite of its very long life, emits fairly hard β -rays of a mean

energy of about 5×10^5 e.v., has been discussed repeatedly. The discrepancies between theory and experiment would be somewhat lessened if it could be shown that the natural radioactivity of potassium is due to K^{40} , but this difficulty would still remain. It is of interest to note in this connexion that the artificially produced isotope of potassium 42, though having a similar period to thorium B, emits β -rays of more than ten times greater mean energy than the latter. Also, the nucleus of this potassium isotope is thus emitting much harder rays than members of the radioactive disintegration series of similar period.

G. HEVESY.

Institute for Theoretical Physics,
Copenhagen. Dec. 23.

¹ cf. G. Hevesy, M. Pahl and R. Hosemann, *NATURE*, 134, 377, Sept. 8, 1934.

² *Ricerca Scientifica*, 2, December 1934.

Absorption of Cosmic Particles in Copper and Lead

By the method of the coincidences between three Geiger-Müller counters of 2.5 cm. diameter and 25 cm. effective length, disposed as in Fig. 1, I have carried out comparative measurements of absorption of the hard component of cosmic particles in copper (atomic weight (A) = 63.57; atomic number (Z) = 29) and in lead (A = 207.20; Z = 82). Lead screens (altogether 9 cm.) were arranged permanently between the counters, in order to exclude softer particles.

The absorbing screens, made of bars of surface area 2.5 cm. \times 30 cm., were interposed between the first and second counter: they had the same mass per cm.² of 575 gm./cm.²; the bars of lead were arranged in such a way as to occupy altogether the same height as the copper screen.

The triple coincidences were recorded by an automatic device¹, the resolving power of which, determined according to the double chance-coincidences, was 6×10^{-4} sec.: with this resolving power the expected number of triple chance-coincidences is 0.08 an hour.

The results given in Table I were obtained by alternating regularly the measurements taken without absorbing screen between the counters with those taken with the screens of copper and lead.

In the course of these measurements, the triple coincidences with the middle counter displaced laterally 3.2 cm. were also recorded in order to test the reliability of the method. Table II shows that not more than about a tenth of coincidences observed in the preceding case can be attributed to primary particles scattered by the screens or to secondary ones generated near the counters.

From the results reported in Table I there does not appear to be any difference, within the limit

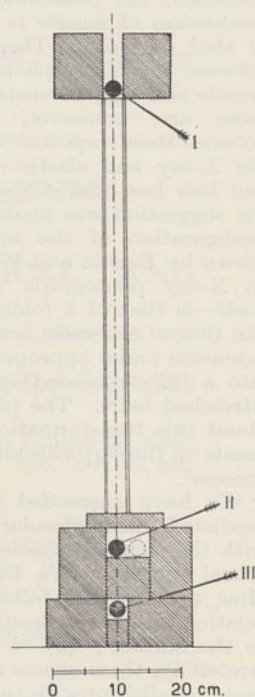


FIG. 1.

of experimental errors, between the absorption of cosmic particles filtered through 9 cm. of lead, in copper and lead, the mass per cm.² of the screens being equal. This absorption in 575 gm./cm.² is (37.6 ± 3.2) per cent.

TABLE I. Counters in line.

	Permanent screen of 9 cm. of lead	Copper (575 gm./cm. ²)	Lead (575 gm./cm. ²)
Time observation (hours)	300-00	300-00	300-00
Triple coincidences observed	962	608	601
Triple coincidences per hour	3.206 ± 0.103	2.002 ± 0.082	2.000 ± 0.081

If the absorption were proportional to the number of electrons per cm.², the values of the absorption for the two screens of equal mass per cm.² should be in the ratio of $(Z/A)_{Cu}/(Z/A)_{Pb} = 0.87$; that is, a difference of 13 per cent would be expected. The measurements reported (as, indeed, others carried out on the absorption of particles of lower range³) do not reveal such difference: it appears therefore that the absorption may be rather connected with the mass per cm.² than with the number of electrons per cm.²: however, the statistical error of measurements, which amount to 8.83 per cent in comparison between the absorption of copper and lead, does not make this quite certain.

TABLE II. Middle counter displaced.

	Permanent screen of 9 cm. of lead	Copper (575 gm./cm. ²)	Lead (575 gm./cm. ²)
Time of observation (hours)	100-00	103-93	101-62
Triple coincidences observed	42	26	22
Triple coincidences per hour	0.420 ± 0.066	0.250 ± 0.049	0.217 ± 0.046

What is certain, however, is that there does not exist for the absorption of the cosmic particles any marked dependence on the atomic number of the absorbing screen of the kind of that which has been found³ for the absorption of the shower-producing radiation.

I beg to express my thanks to Prof. B. Rossi, who advised me to make this research.

GIULIA ALOCCO.

Physical Institute,
University, Padua.
Dec. 1.

¹ B. Rossi, *Ricerca Scientifica*, V, 2, 561; 1934.² G. Alocco, *Ricerca Scientifica*, V, 2, 91; 1934.³ B. Rossi, *NATURE*, 132, 173; 1933.

Terrestrial Magnetism and Cosmic Rays

It has been shown by several observers within the last few years that the ionisation caused by cosmic radiation, when reduced to the same barometric pressure, is not constant. In addition to a very small regular diurnal variation, the existence of which has been proved by continuous registration over a period of three years at 2,300 metres above sea-level¹, much larger and irregular variations have been found by different observers ("Schwankungen

zweiter Art", as they were termed by A. Corlin). These are clearly perceivable when, for example, hourly observations of the cosmic ray intensity (or even the daily mean values) are reduced to standard pressure. At the Hafelekar Observatory in the Tyrolean Alps (2,300 m.) the daily average intensities may differ by so much as 0.10 *J.*, that is, by 4 per cent (total ionisation with complete lead screen 10 cm. thick on all sides of the apparatus amounting to about 2.80 *J.*). With apparatus unscreened from above, even larger variations may occur.

The so-called latitude effect of the cosmic radiation suggests a possible explanation of these irregular 'variations of the second kind'; for W. Messerschmidt² has found that these irregular variations, as observed in a three-month series by the Hoffmann standard apparatus in Halle (Germany), were related to simultaneous variations of the horizontal intensity of the terrestrial magnetic field; a decrease of the latter seemed to cause an increase of the daily average cosmic ray ionisation, and vice versa.

We thought it worth while to investigate whether a similar relationship holds also in our observations at the Hafelekar. In order to eliminate the influence of the regular daily variations, we calculated the average cosmic ray intensity for each day of the year 1933 on which at least eighteen hourly observations were registered. Our observations were carried out partly with a lead screen of 10 cm. thickness on all sides of the apparatus, and partly with the screen underneath and on the sides but not on top. The former were made as a rule from the 1st to the 10th and from the 21st to the end of each month, the latter from the 11th to the 20th, according to an agreement with several colleagues abroad who were taking similar observations of the cosmic ray intensity in different places, ranging from lat. 68° N. to lat. 35° S.

The mean horizontal intensity *H* of terrestrial magnetism was calculated for each day from registrations of the Terrestrial Magnetic Station, Vienna-Auhof, by the formula

$$H = \frac{1}{24} (h_0 + 2h_2 + 2h_4 + 2h_6 + \dots + h_{24}),$$

where *h*₀, *h*₂, etc., denote the observed magnetic intensities at 0h, 2h, 4h, etc. These data were kindly placed at our disposal by Prof. Wilhelm Schmidt, director of the Meteorologische Zentralanstalt, Vienna.

Diagrams were then drawn for each 10-day and 20-day interval, showing the variations of the cosmic ray intensity (*a*) with complete screening (10 cm. lead on all sides), and (*b*) with no lead on top of the apparatus, with the variations of the average horizontal magnetic force from day to day. The latter varied between 20,470 γ and 20,530 γ, while the maximum of the cosmic ray fluctuation in case (*a*) amounted to about ± 0.05 *J.* (average 2.80 *J.*), in case (*b*) to ± 0.06 *J.* (average 4.6 *J.*), in the course of one year.

From the diagrams we were unable to obtain unambiguous evidence of any connexion between the variations of the horizontal component of the earth's magnetic field and of the cosmic ray intensity. There were even periods of several days in which an increase of the horizontal magnetic intensity was accompanied by an increase of the ionisation of the cosmic rays.

We therefore thought it best to calculate the correlation coefficients (*r*) between the daily means

of the cosmic ray ionisation and the horizontal magnetic intensity. This was done using Charlier's method³. Taking all observations of the year 1933 (eleven months, since in April no observations were taken) we obtained the following values:

Case (a) (10 cm. lead screen on all sides)	$r = -0.12$	} (January to December 1933)
Case (b) (no lead screen on top of apparatus)	$r = -0.28$	

The negative values of r indicate that, on the whole, an anti-parallelism between the two magnitudes does exist, in concordance to W. Messerschmidt's results. The numerical values of r are very low, therefore we must conclude that the relationship is rather slight.

It is remarkable, however, that if we exclude the first three months of 1933, in which several slight alterations of our Steinke apparatus had to be made, we obtain a much better correlation:

Case (a) (10 cm. lead on all sides)	$r = -0.19$	} (May to December 1933)
Case (b) (no lead screen on top of apparatus)	$r = -0.57$	

The correlation in case (b) is very good, thus indicating that the soft components of the cosmic radiation entering the apparatus when it is not screened from above are more influenced by variations of the horizontal intensity, and this is what is to be expected.

We conclude that our observations indicate that the so-called 'variations of the second kind' of the cosmic radiation are partly due to variations in the opposite sense of the horizontal component of the earth's magnetic field.

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¹ V. F. Hess, H. Th. Graziadei and R. Steinmaurer, *Sitz. Ber. Acad. Wiss. Wien*, **143**, 313-333; 1934.

² W. Messerschmidt, *Z. Phys.*, **85**, 332; 1933.

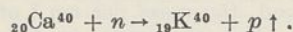
³ C. V. L. Charlier, "Vorlesungen über die Grundlagen der mathematischen Statistik", Verlag Scientia, Lund, 1920, chap. xiv (Class-Method).

Radioactivity of Potassium

FERMI failed to detect induced β -radioactivity with calcium bombarded by neutrons, and this fact has been attributed¹ to the existence of a closed neutron shell in the calcium nucleus. We suggest alternatively that the failure to detect radioactivity may constitute a proof that the source of the natural radioactivity of potassium is the isotope ${}_{19}\text{K}^{40}$ of such small abundance that it cannot be detected by means of the mass-spectrograph.

Aston's work indicates that ${}_{20}\text{Ca}^{40}$ is by far the most abundant calcium isotope, the ratio of ${}_{20}\text{Ca}^{40}$ to ${}_{20}\text{Ca}^{44}$ being 70 to 1, the other isotopes of mass number 42 and 43 being present in very small amounts. Thus by far the greater number of neutrons will interact with ${}_{20}\text{Ca}^{40}$ and it seems reasonable, therefore, to suggest that any radioactivity induced in isotopes other than ${}_{20}\text{Ca}^{40}$ will be too slight to be detectable. In addition, Fermi has definitely detected proton emission following neutron capture with ${}_{12}\text{Mg}^{24}$, ${}_{13}\text{Al}^{27}$, ${}_{14}\text{Si}^{28}$, ${}_{15}\text{P}^{31}$, ${}_{16}\text{S}^{32}$, ${}_{24}\text{Cr}^{52}$ and ${}_{30}\text{Zn}^{64}$, and of these seven isotopes five have even atomic number. It therefore appears likely that the follow-

ing reaction occurs when calcium is bombarded with neutrons:



As a result of such an action, only a very small number of radioactive potassium nuclei could be produced, and assuming ${}_{19}\text{K}^{40}$ is the source of the natural radioactivity of potassium, the long life of this isotope explains why no disintegrating electrons were observed.

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¹ Wenli Yeh, *C.R.*, **199**, 1209; 1934.

Radioactivity Induced by Neutrons

AMALDI, d'Agostino and Segrè¹ report that, using neutrons from a radon-alpha particle-beryllium source, they have induced an activity in indium of a very short half-life period (13 sec.) and also one of half-life period of about one hour (54 min.).

Our own unpublished observations on indium show the one hour period and a longer period of several hours (estimated at $3\frac{1}{2}$ h.). If indium is irradiated in air these two periods show strong initial intensities of the same order of magnitude, but if it is irradiated in water, the one hour period is so strongly reinforced that it overshadows the long period and may thereby prevent its detection. Thus three periods appear to exist for indium, and the two shorter ones of these are reported² to be strongly water-sensitive.

Indium has two known isotopes³ (mass numbers 113 and 115, the ratio of their abundance being less than one to ten). It has an odd atomic number and since, apart from the isolated case of hydrogen, there is no precedent for such an element having more than two isotopes, we tentatively assume that no further stable indium isotope is involved. Accordingly we conclude that one of the two indium isotopes is activated with more than one period.

The question arises whether the observed periods can be interpreted on the basis of the primary processes which have so far been recognised in the Fermi effect. These recognised processes are: (a) capture of the neutron by the nucleus (all cases so far investigated were reported to be water-sensitive); (b) ejection of a heavy positively charged particle—a proton or an alpha particle—from the nucleus (all cases so far investigated were reported not to be water-sensitive). Some isotopes of lighter elements are known to be activated with two or three periods, the ejection of a proton or an alpha particle being quite a common process for elements lighter than zinc (atomic number 30). No such processes have so far been observed for elements heavier than zinc.

In the circumstances the Fermi effect of indium (atomic number 49) seems to deserve further investigation, for which adequate instruments of observation are not at present at our disposal.

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¹ Amaldi, d'Agostino, Segrè, *Ricerca Scientifica*, **V**, **2**, No. 9-10 November 1934.

² Amaldi, d'Agostino, Fermi, Pontecorvo, Rasetti, Segrè, *Ricerca Scientifica*, **V**, **2**, No. 11-12, December 1934.

³ Wéhrli, *Helvetica Physica Acta*, **7**, **6**, 611; 1934.

Induced Radioactivity produced by Neutrons liberated from Heavy Water by Radium Gamma-Rays

WORKING in this laboratory, Szilard and Chalmers¹ have shown that neutrons are liberated from beryllium irradiated by radium gamma-rays, and that they are capable of inducing radioactivity in a number of elements. Previously, Chadwick and Goldhaber² had reported that, using an ionisation method, they had observed the liberation of protons from heavy hydrogen which was irradiated by gamma rays from thorium C.

In the light of these observations, and having regard to possible biological applications of heavy water, it is of interest to determine whether the neutrons presumed to be liberated by the gamma-ray disintegration of heavy hydrogen can activate other elements.

We have succeeded in observing the radioactivation of iodine and bromine which had been bombarded by the neutrons liberated from heavy water irradiated by radium gamma-rays. In one series of experiments we used 10 c.c. of heavy water of 30 per cent concentration, and irradiated it with gamma-rays from 150 mgm. of radium filtered by 1 mm. of platinum. The heavy water almost completely filled the space between the double walls of a glass container similar in construction to a diminutive cylindrical Dewar vessel. The radium occupied the central cavity of the container, which was immersed in 400 c.c. of ethyl iodide.

After irradiation, the radio-iodine was precipitated and removed from the ethyl iodide by the method of isotopic separation described by Szilard and Chalmers³, and its activity measured on a Geiger-Müller β -ray counter. Using the quantities above mentioned, the counter recorded an average of 110 impulses in 5 minutes, whereas the control experiments carried out with 10 c.c. of ordinary water contained in a duplicate vessel gave 55 impulses against a normal 'background' of 30-35 impulses in 5 minutes. We attribute the difference in count between the normal 'background' and the control experiments with ordinary water to primary neutrons emitted by the source.

A similar series of experiments, in which 300 c.c. of bromoform was substituted for the ethyl iodide, gave strictly comparable results with radio-bromine to those obtained with radio-iodine. We conclude that neutrons emitted from heavy water irradiated by radium gamma-rays are capable of inducing radioactivity in iodine.

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¹ NATURE, 134, 494, Sept. 29, 1934.

² NATURE, 134, 237, Aug. 18, 1934.

³ NATURE, 134, 462, Sept. 22, 1934.

Spectrum of Ordinary Hydrogen (H_2)

I HAVE recently found several systems of bands in which the electronic transitions are from new upper states of H_2 down to the singlet state generally denoted by 1X . These band systems are of importance and interest for a variety of reasons.

I gather that there is no general agreement as to what the electronic configuration of the final state 1X is, but I have put forward what I believe strong reasons for thinking it to be the $1s\sigma 2s\sigma^1\Sigma_g$ state which otherwise would, quite unaccountably, be missing. Hitherto, our knowledge of 1X , derived from the analysis of the $^1X \rightarrow 2p^1\Sigma$ system, has been very meagre except at the vibrational levels $v = 1$ and 2. These levels have a very irregular rotational structure and so also had the $v = 3$ level according to the old analysis.

This has generally been supposed to be due to uncoupling, which is impossible if the state is $1s\sigma 2s\sigma^1\Sigma$, or to some other type of perturbation. I have recently repeated the former analysis of the $^1X \rightarrow 2p^1\Sigma$ system and have found an error at the $v' = 3$ level and some new lines. These changes make the rotational structure of the $v' = 3$ level quite regular as H_2 levels go. As a result of the analysis of the new systems ending on 1X , I have found what I believe to be the $v = 0$ level of this state. It has a quite regular rotational structure and is about what one would expect *a priori* for $1s\sigma 2s\sigma^1\Sigma$, so that the most serious objection to the identification of 1X with $1s\sigma 2s\sigma^1\Sigma$ has now disappeared. The cause of the rotational irregularity at the $v = 2$ and 3 levels is still a mystery. The difficulty about attributing it to a perturbation is that there is no known state, and so far as can be foreseen no possible state, which could be in the position and have the other properties theoretically necessary to cause a perturbation.

The strength of the new systems, which are weak, lies mainly along the diagonal axis in each case. So far, three systems seem to have emerged definitely, but there are indications of the existence of others. The upper states of the three I call provisionally 1D , 1R and 1U . The analysis of these has gone far enough to enable some definite, though preliminary, statements to be made about them.

The system $^1D \rightarrow ^1X$ lies in the infra-red around 8000 Å. I believe that the upper state 1D is the same as the D state of Hopfield, to which he found strong transitions up from the ground state in the absorption spectrum of H_2 . At least if my interpretation¹ of Hopfield's data be accepted, they lie close together and have similar properties. An analysis of the $v = 2$ and 3 levels of 1D (I have not yet found the $v = 0$ level and the $v = 1$ level is not very secure) gives the following approximate electronic constants: v_0 (depth from the ground level of the molecular ion) 11267 wave numbers, Rydberg denominator $3 \cdot 12$, fundamental frequency (ω_0) 2300 wave numbers. The corresponding quantities for Hopfield's D state which I derived from his absorption data are: v_0 11560, $R.d.$ 3.08, ω_0 2257, $x\omega_0$ 59.5. These data also involve an extrapolation from higher but different vibrational levels down to the $v = 0$ level, so that exact agreement is not to be expected. I think that 1D is $1s\sigma 3p\pi^1\Pi_u$, but the possibility that it might be $1s\sigma 3p\sigma^1\Sigma_u$ is not yet absolutely excluded.

The system $^1R \rightarrow ^1X$ lies around $\lambda 5900$ Å. The v_0 of 1R is about 6400 giving a denominator of $4 \cdot 14$, ω_0 is about 2230 and $x\omega_0$ about 60. I think 1R is $1s\sigma 4p\pi^1\Pi_u$, but here again $1s\sigma 4p\sigma^1\Sigma_u$ is also possible. $^1U \rightarrow ^1X$ lies around $\lambda 5400$ Å. The approximate numerical data for 1U are $v_0 = 4900$ wave numbers, $R.d. = 4 \cdot 74$, ω_0 about 2220 and $x\omega_0$ about 45. I think this state is most likely to be $1s\sigma 5p\sigma^1\Sigma_u$, but there are some lines about which look like Q branches, so it may be

a Π state. In that case it may be either $1s\sigma 5p\pi^1\Pi_u$ or $1s\sigma 5f\pi^1\Pi_u$, but I think it certain that it has one unexcited electron ($1s\sigma$). All the other properties of the new upper states are in agreement with what would be expected for these assignments.

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¹ "Molecular Hydrogen and its Spectrum", pp. 303 ff.

Fluorescence of Fluorite and the Bivalent Europium Ion

EXPERIMENTS conducted in this Institute¹ had led to the conclusion that the blue fluorescence of fluorite excited by filtered ultra-violet light is due to traces of europium under the influence of radioactive substances, and that a yellow-green fluorescence which some fluorites show at the temperature of liquid air—especially those from acid magmatic rocks—is, in the same way, due to ytterbium. As these rare earths are those most readily obtained in the bivalent form², as further the reducing action of Becquerel rays is well known, and as the blue fluorescence can also be obtained in CaF_2 containing europium, simply by reduction through heating, the hypothesis was put forward that these broad 'radio-photofluorescence' bands are to be ascribed to the *bivalent* forms of the rare earths.

Through the courtesy of Prof. G. Jantsch, of Graz, we are now able to *prove* this hypothetical assumption in the case of europium. Prof. Jantsch kindly lent us preparations, made in the Institut für anorgan. chem. Technologie und analyt. Chemie of the Technische Hochschule, Graz, of pure SmCl_3 , SmCl_2 , EuCl_3 and EuCl_2 , of which the last shows, when excited by filtered ultra-violet light, a brilliant purplish pink fluorescence, as already noticed by Prof. Jantsch. Spectrograms of this fluorescence, taken by Miss B. Karlik in this Institute, show a broad band in the blue, identical with the well-known fluorite band, and in the red a rather narrow line at $690 \text{ m}\mu$, as well as a diffuse band with a maximum at about $630 \text{ m}\mu$, which strikingly resembles a red band shown by some fluorites but also by synthetic 'pure' CaF_2 after suitable heat and radium treatment. Whilst there can be no more doubt about the blue fluorite band being due to bivalent europium, the question if the red band in fluorite is also to be attributed to minute traces of this substance must form the subject of further investigations.

EuCl_3 and SmCl_2 show no fluorescence, the latter perhaps because of its deep black colour. SmCl_3 fluoresces orange³, with lines at 603.5 and $598.5 \text{ m}\mu$. It is to be hoped that these observations may also furnish new clues to the atomic structure of the rare earths. A detailed report will be presented to the Vienna Academy of Sciences.

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Quasi-Crystalline Structure of Liquids and the Raman Effect

It is known that at the scattering of light in liquids a continuous spectrum appears¹ around the primary line on both sides to a distance of about $15\text{--}20 \text{ \AA}$. This effect is usually referred to as 'wings'.

These wings are generally ascribed to unresolved rotation Raman lines. It seemed to one of us² more probable that the appearance of wings is connected not with rotation of molecules but with a new type of frequency change of the scattered light found by one of us³. For several years the wing phenomenon has been systematically investigated in our laboratory in various compounds and in different experimental conditions. One of us (E. G.) has investigated the influence of temperature on the wings. It might be expected that the raising of temperature would cause a broadening of wings, if they were really due to rotations of the molecules, but no difference could be found in the breadth of wings given by xylene at $t_1 = 15^\circ \text{ C}$. and $t_2 = 160^\circ \text{ C}$. ($T_2/T_1 = 1.5$). Only a slight increase of the intensity of the wings just near the primary line could be noticed. With diphenyl ether, $(\text{C}_6\text{H}_5)_2\text{O}$, which could be heated to 250° C . ($T_2/T_1 \approx 2$), we have obtained similar results, the only difference being that the increase of intensity just near the primary line was more pronounced. Therefore we can conclude that the wings consist of two different parts behaving differently on heating: an inner part (about 20 cm^{-1}) in the closest vicinity of the primary line, and an outer and much greater part. The absence of broadening of the second part on heating is opposed to the rotation hypothesis. This part behaves on heating like vibrational Raman lines and could be attributed to the loosely bound vibrations.

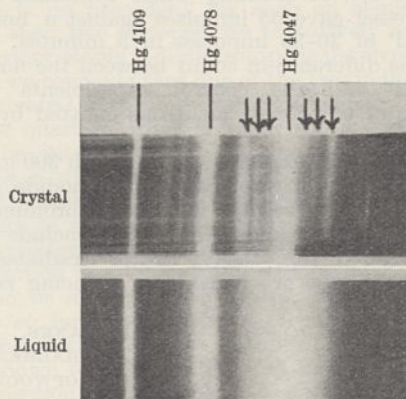


FIG. 1. Raman effect of crystalline and liquid diphenyl ether.

With the view of putting the vibrational and rotational hypothesis to the test, we have investigated the Raman effect in a crystal of diphenyl ether, and have obtained most interesting results. Instead of wings, we obtained on their position four lines lying on both sides of the primary line (Stokes and anti-Stokes lines). Some of the lines, marked by arrows, are clearly seen in Fig. 1. These lines correspond to infra-red frequencies of $\nu_1 = 21 \text{ cm}^{-1}$, $\nu_2 = 39 \text{ cm}^{-1}$, $\nu_3 = 69 \text{ cm}^{-1}$ and $\nu_4 = 100 \text{ cm}^{-1}$. These new lines are the vibrational Raman lines and not the rotational ones, for the following reasons:

¹ H. Haberlandt, B. Karlik and K. Przibram, *Wien Ber.*, IIa, 143, 151; 1934. See also *NATURE*, 133, 99; 1934.

² G. Jantsch and W. Klemm, *Z. anorgan. Chem.*, 216, 80; 1933.

³ For the line-fluorescence of other trivalent rare earth salts, see R. Tomaschek and O. Deutschbein, *Phys. Z.*, 34, 374; 1933 and M. Haitinger, *Wien. Ber.*, IIa, 142, 339; 1933.

(1) The distances between the lines are unequal and of different order of magnitude from that determined by the moments of inertia of the diphenyl ether molecule.

(2) The intensity of the lines $\nu_1=21$ cm.⁻¹ and $\nu_4=100$ cm.⁻¹ is greater than that of $\nu_2=39$ cm.⁻¹ and $\nu_3=69$ cm.⁻¹. When the crystal is melted, these lines broaden into a continuous spectrum (wings), while other Raman lines do not undergo any marked change. It seems, therefore, that we can ascribe the former lines to vibrations characteristic of the crystal lattice and the latter to molecular vibrations. The fact that the former lines do not disappear in the liquids shows that apparently some elements of the crystal lattice remain, although deformed, also in the liquid state.

A more careful investigation of the Raman spectrum of liquid diphenyl ether showed that a broad diffuse maximum of intensity appears in the region of the wings corresponding to the strong line $\nu=100$ cm.⁻¹ in the crystal. On raising the temperature to 250° C., this maximum broadened until it could not be noticed against the continuous spectrum of the wings.

All these observations are in good agreement with the theory of the quasi-crystalline structure of liquids often discussed in connexion with the diffraction of X-rays⁴.

In some degree the appearance of the wings is characteristic for most, if not for all, liquids. There is no reason to expect that in other liquids (such as benzene), this phenomenon has a different origin from that in diphenyl ether. Thus, generalising the above results, we may say:

(1) The usually accepted explanation of the wings is not correct. This phenomenon is principally due not to the rotational but to the vibrational Raman effect. A slight asymmetry in the intensity distribution on the red and the violet side⁵ as well as the dependence on the primary frequency⁶ is easily explained.

(2) The part of the wings adjacent to the primary line, which grows in intensity with rising temperature, is probably a prolongation of the continuous spectrum observed⁷ between the components of the Rayleigh line by instruments of great resolving power. Perhaps for this part of the wings the rotation hypothesis is valid, though it may be connected also with Debye heat vibrations.

(3) Our experiments give new facts in support of the theory of the quasi-crystalline structure of liquids. They indicate the possibility of examining this problem by means of the Raman effect.

At the present time, detailed investigations of the wings from this new point of view are in progress in our laboratory with different compounds in the liquid, crystal and gaseous states.

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Identity of the Growth-Promoting and Root-Forming Substances of Plants

IN a recent brief communication on the chemical nature of the root-forming hormone of plants¹, the following evidence was brought forward:

(1) The hormone is an organic acid, dissociation constant about $10^{-4.5}$, the activity of which is readily destroyed by oxidising agents.

(2) The hormone has about the same solubilities in various organic solvents, and distils in the same temperature range *in vacuo*, as the auxin, or growth-promoting hormone, obtained from *Rhizopus suinus*.

(3) The crystalline auxin preparations prepared by Kögl and co-workers from urine² show root-forming activity, and their activity is destroyed by oxidising agents; when the destruction is partial, the root-forming and growth-promoting activities are destroyed to the same extent.

The evidence thus points to the identity of the two hormones, but on account of the inconstancy of the ratio of the two kinds of activities in various preparations and for other reasons, the matter was left open.

It has since been found by Kögl, Haagen-Smit and Erxleben³, that one of the active growth-promoting hormones present in urine is identical with β -indolyl-acetic acid. We have, therefore, prepared this substance synthetically, and find it to be fully active in promoting root formation. The possibility of an active impurity in the products obtained from natural sources scarcely arises in the case of a pure synthetic compound, and no doubt therefore remains that, of the factors promoting root formation, this one is identical with that which gives rise to growth by cell elongation. The pure substance has an activity of from 7.4 to 28×10^4 root units per mgm., and a growth-promoting activity of 31×10^4 growth-stimulating units per mgm., hence a ratio root units to growth-stimulating of from 0.2 to 0.7 . This agrees satisfactorily with the figures previously quoted by us for the crystalline auxins of Kögl and co-workers¹, so that the root-forming activity of these substances could not have been due to traces of impurities either. It may be noted that the ratio between our growth units and those of the Utrecht workers, previously deduced on theoretical grounds⁴, would give β -indolyl-acetic acid an activity of 2.5×10^7 Avenae units (A.E.) per mgm., compared with 1 to 2×10^7 A.E. per mgm. given by Kögl and co-workers.

The fact that two such different functions as the formation of roots on cuttings and the growth of tissues by cell elongation should be brought about by the same specific substance raises interesting questions of mechanism, particularly since all three of the substances are about equally active in both functions.

The homologues of β -indolyl-acetic acid, namely β -indolyl-propionic and indole- β -carboxylic acids, are without activity in root formation; they were correspondingly shown to be inactive in growth promotion by Kögl, Haagen-Smit and Erxleben³. Our own preparations and tests confirm the results of the latter workers in respect of growth promotion. Indole itself is also inactive. The propionic derivative, which was a commercial product, showed, even after two recrystallisations, slight growth-promoting activity in concentrated solutions, due doubtless to the persistence of traces of its lower homologue. The activity, which was less than 0.2 per cent of that of β -indolyl-acetic acid, was still further reduced on again recrystallising.

¹ C. V. Raman and K. S. Krishnan, NATURE, 122, 278; 1928. T. Cabannes and P. Daure, C.R., 186, 1533; 1928.

² E. Gross, NATURE, 124, 400; 1930.

³ E. Gross, NATURE, 124, 201; 1930. 129, 722; 1932.

⁴ For example, G. W. Stewart, Rev. Modern Phys., 2, 116; 1930

⁵ W. Gerlach, Ann. Phys., 1, 301; 1929.

⁶ T. Weiler, Z. Phys., 68, 782; 1931.

⁷ E. Gross, NATURE, 124, 400; 1930.

The test for root-forming activity, using pea cuttings, has been described by Went⁵. The β -indolyl-acetic acid was prepared by the method of Majima and Hoshino⁶. The indole- β -carboxylic acid was prepared by direct combination with carbon dioxide as described by Zatti and Ferratini⁷.

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¹ K. V. Thimann and F. W. Went, *Proc. Kon. Akad. Wetensch.*, Amsterdam, 37, 456; 1934.
² *Z. physiol. Chem.*, 214, 241; 1933.
³ *ibid.*, 228, 104; 1934.
⁴ K. V. Thimann and J. Bonner, *Proc. Roy. Soc.*, B, 113, 145; 1933.
⁵ *Proc. Kon. Akad. Wetensch.*, Amsterdam, 37, 445; 1934.
⁶ *Ber.*, 58, 2042; 1925.
⁷ *Ber.*, 23, 2296; 1890.

Starvation and Regenerative Potency in
Dendrocoelum

THE regenerative potency of Planarians may be depressed in several ways, for example, by irradiation (Wiegand, 1930, and others), or by repeated regeneration of the head-region (10 days after a previous amputation: Sivickis, 1931). This has been interpreted by some authors as due to a reduction in

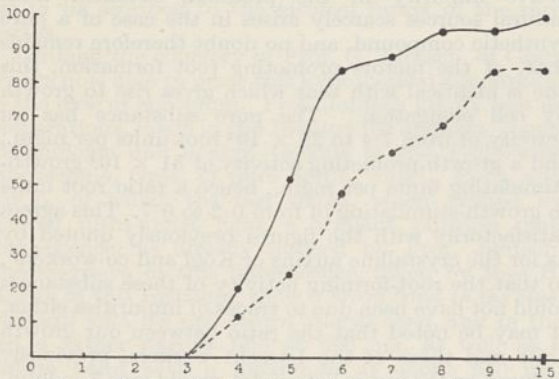


FIG. 1. Regeneration in starved *Dendrocoelum* (dotted line) and normal control (continuous line); ordinates, percentage of regenerates showing eyes; abscissae, time in days.

the amount of formative material available, by others as due to alterations in the general metabolism of the body and the degree of differentiation of the tissues involved (Sivickis).

Well-fed stocks of defined degrees of starvation were taken, their heads amputated, and observation continued for 15 days (for details see Sivickis). The appearance of eyes were taken as the criterion of successful regeneration. Four series, differing slightly in detail as to level of cut, degree of starvation and temperature, have given concordant general results, in that the regenerative potency was always lower in the starved stocks, regeneration being delayed, and (in three of the four series) the percentage of non-regenerating specimens increased (see Fig. 1 and table). The proportion of non-regenerating specimens for all series was 0 per cent for controls and 10 per cent for the starved stocks, although the mortality rate of the latter was not increased at all.

Starvation thus has the same effect on regeneration as radium treatment or as previous head-amputation (see especially Sivickis, Fig. 3). This indicates with a high degree of certainty that the reduction of regenerative potency in all three cases is due to a reduction in the amount of formative material available for regeneration. Studies on the histology of starvation (for example, Schultz, 1904, Stoppenbrink, 1905, Berninger, 1911, Bartsch, 1923) clearly show that such material is used up during starvation, and the work of Steinmann (1925, 1926) shows the close resemblance of the histological changes observed in starvation and in regeneration.

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Stoppenbrink, F., *Z. wiss. Zool.*, 79; 1905.
Weigert, K., *Z. wiss. Zool.*, 136; 1930.

Duration of Life-Cycle of the Death-Watch
Beetle

So far as published accounts record, the death-watch beetle (*Xestobium rufovillosum*, De G.) has never been bred in the laboratory and no study has, therefore, been possible of the factors affecting its development and the duration of its life-cycle. In discussing the treatment of timber roofs attacked by *Xestobium*, Lefroy¹ summarised in 1924 the knowledge of the biology of the insect up to that time and pointed out how little was known of its life-history and habits.

During the past four years, a study of the life-cycle and duration of the different stages of the insect has been in progress at the Forest Products Research Laboratory, and in the course of this work the beetle has been reared from egg to adult. The results of this investigation—a full account of which will be published elsewhere—lead to the general conclusion that, given a suitable timber, for example, oak or willow, the

Series	Anterior level of cuts	Days of starvation	Number of cut pieces			Number survived at the end of expt.			Number of regenerations			Delay in time of completion of regeneration
			starved	control	Σ	starved	control	Σ	starved	control	Σ	
1.	A ¹	10	25	25	50	23	22	45	23	22	45	> 24 hours
2.	A ¹	8-10 ²	25	25	50	21	23	44	18	23	41	> 24 hours
3.	B ²	8-10 ²	25	25	50	16	16	32	14	16	30	> 24 hours
4.	A ¹	20	25	25	50	25	25	50	21	25	46	> 24 hours
Summary			100	100	200	85	86	171	76	86	162	

¹ Closely posterior to eyes. ² Midline between eyes and pharynx. ³ Judged only by the colour of the intestine.

To test these ideas, experiments were undertaken on the effect of starvation. For this purpose, the abundant species *Dendrocoelum lacteum* is very convenient, since the degree of starvation is reflected in the colour of the animals, the dark gut contents showing through the translucent white body.

progress at the Forest Products Research Laboratory, and in the course of this work the beetle has been reared from egg to adult. The results of this investigation—a full account of which will be published elsewhere—lead to the general conclusion that, given a suitable timber, for example, oak or willow, the

length of the life-cycle of *Xestobium* depends upon : (a) condition of the timber with reference to fungal decay ; (b) moisture content of the timber ; (c) temperature conditions.

For example, the insect has been reared in the remarkably short period of 11 months in willow in an advanced stage of decay at moisture content of 18-20 per cent (based on dry weight of wood) and at a temperature of 20°-25° C. On the other hand, under similar conditions of temperature and humidity, but with wood in a very much less advanced stage of decay, the beetle has not yet completed its development after a period of 22 months. Furthermore, at temperatures of 20°-25° C., the duration of the life-cycle of the insect reared in oak sapwood, in varying stages of decay, and at moisture contents less than 18 per cent, occupied 28-30 months and longer. Under out-of-door conditions in decayed oak and willow, it has been prolonged still further and has not yet been completed.

Now that it is possible to breed *Xestobium* in the laboratory, further work is in progress on the relationship between the type and extent of fungal decay in timber and its susceptibility to attack. The results so far obtained, however, lend support to the view that the development of *Xestobium* in buildings is extremely slow unless conditions unusually favourable for rapid decay of the timber are present.

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Dec. 18.

¹ *J. Roy. Soc. Arts*, 72, (3720) ; 1924.

Transformations of Isomeric Sugars

DEFINITE evidence is now available of the correctness of the views expressed in our former letter on this subject¹, as, in a smooth series of reactions, we have succeeded in converting *d*-glucose into *d*-galactose and *l*-gulose. The two transformation sugars have been isolated separately and identified.

Starting from α -methylglucoside, an anhydro ring was formed between positions 3 and 4 of the glucose chain as a result of consecutive reactions which gave as the end product an amorphous 2-acetyl 3:4-anhydro 6-trityl α -methylhexoside. After opening the anhydro ring, two distinct acetone derivatives were obtained, namely :

(a) A monacetyl monacetone methylhexoside, m.p. 101°-102°, $[\alpha]_D + 127.3^\circ$ in chloroform.

(b) A monacetyl monacetone methylhexoside, m.p. 176°-178°, $[\alpha]_D + 76.8^\circ$ in chloroform.

On deacetylation, the compound (a) gave a theoretical yield of a monacetone methylhexoside, m.p. 109°-110°, $[\alpha]_D + 147.2^\circ$, from which, on partial hydrolysis, α -methylgalactoside was obtained which showed correct melting point and mixed melting point and a specific rotation of +175.5° in water. From this, in turn, *d*-galactose was isolated and identified by determination of the optical activity and by conversion into the phenylosazone.

In a parallel series of reactions, the isomeride (b) gave a monacetone methylhexoside, m.p. 132°-133°, $[\alpha]_D + 88.5^\circ$ in chloroform. On complete hydrolysis to the parent sugar, the rotation became *levo*, $[\alpha]_D - 17.9^\circ$, and as the phenylosazone melted at 156°, the product was evidently *l*-gulose. The scission of the 3:4-anhydro ring in glucose may give four possible products : *d*-glucose, *d*-allose, *d*-galactose

and *l*-gulose, and doubtless all are present. Of these only *l*-gulose is *laevorotatory*, and its isolation together with *d*-galactose is of special interest in view of the relationship of these hexoses with ascorbic acid and lactose respectively. We are accordingly extending our work with the object, *inter alia*, of converting maltose into lactose.

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Dec. 21.

¹ *NATURE* 133, 871; 1934.

Luminous Night Clouds over Norway in 1933 and 1934

As reported in a letter to *NATURE*¹ large masses of noctilucous clouds were seen over southern Norway in the night of June 30-July 1, 1934. From three of my aurora stations I got a series of simultaneous photographs of these clouds. The plates have now been measured, and the results will soon appear in *Astrophysica norvegica*. The following points from this paper may be of interest :

Seven pairs of plates gave the following 41 heights in kilometres : 82, 83, 82.5, 84, 84, 82.5, 82.5, 82, 83.5, 82, 82, 85, 82.5, 81, 82, 84, 81, 80.5, 81, 82, 81.5, 81, 81.5, 82.5, 82.5, 82, 82, 82.5, 83, 82, 78, 82, 82, 83.5, 82, 82, 81, 83.5, 82.5, 83, 81. The mean, 82.2 km., agrees very well with the mean value 82.08 km. found by Jesse from observations in the years 1889-91. It also agrees with my own measurements from 1932, which gave 81.4 km.

The velocity of the clouds was 80-83 metres a second from east to west. A series of waves with their crests orientated north and south appeared, the distance between successive crests being 6-9 km.

As observed in 1932, sun rays passing nearer to the earth's surface than about 30 km. do not make the clouds shine. This may suggest that the clouds are chiefly illuminated by ultra-violet rays.

From different people I have received observations and photographs of luminous clouds on the following nights : 1933 : July 4-5, 7-8, 9-10, 19-20, and August 9-10, 23-24. 1934 : June 30-July 1, July 5-6, 6-7, 16-17, 17-18, 18-19, 30-31, July 31-August 1, August 7-8.

A very interesting case is the occurrence of such clouds over central Norway on July 19-20, 1933, because similar clouds were observed 33 hours later over Canada², coming from the east-north-east, which corresponds to a drift of 48-57 metres a second, if the clouds had drifted from Norway to Canada. For further details I must refer to the complete paper which is in print.

In conformity to the opinion expressed by Vestine in his paper mentioned above, it seems to me that the luminous night clouds are likely to consist of cosmic dust coming from interplanetary space into the upper atmosphere in the same way as shooting stars and meteors. The arguments in favour of this opinion are the following :

(1) The occurrence of luminous night clouds after the great Siberian meteor (1908), also adduced by Vestine as an argument in favour of a cosmic origin of the clouds.

(2) The occurrence of the clouds in the months of June and July, with a maximum near the end of June, which is comparable with the fact that shooting stars appear at certain fixed dates of the year. The reported occurrences of such luminous clouds in the

summer months of southern latitudes, however, seems difficult to explain as the result of the same swarm of cosmic dust.

(3) The greatest intensity of the phenomenon after midnight is then intelligible in the same way as the analogous maximum of frequency shown by shooting stars after midnight, due to the fact that the morning side precedes in the earth's motion round the sun.

(4) As shown by Vestine, there are more coincidences between luminous night clouds and meteoric showers and comets than between these clouds and volcanic eruptions, which points to a cosmic origin.

(5) The blue-white colour points more to fine dust than to water drops and ice-crystals. This was also pointed out by Vestine.

(6) The sporadic occurrence of the clouds points to irregular precipitations of cosmic dust over limited areas, in particular on the side of the earth which precedes in its motion round the sun.

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Dec. 18.

¹ NATURE, 134, 219, August 11, 1934.
² E. H. Vestine, "Noctilucent Clouds", *J. Roy. Ast. Soc. Canada*, July-September, 1934.

Musical Atmosphericics

THE characteristics of audio musical atmosphericics which are obtained when an audio amplifier is placed in a long line or aerial have been discussed from time to time¹. Messrs. Burton and Boardman have

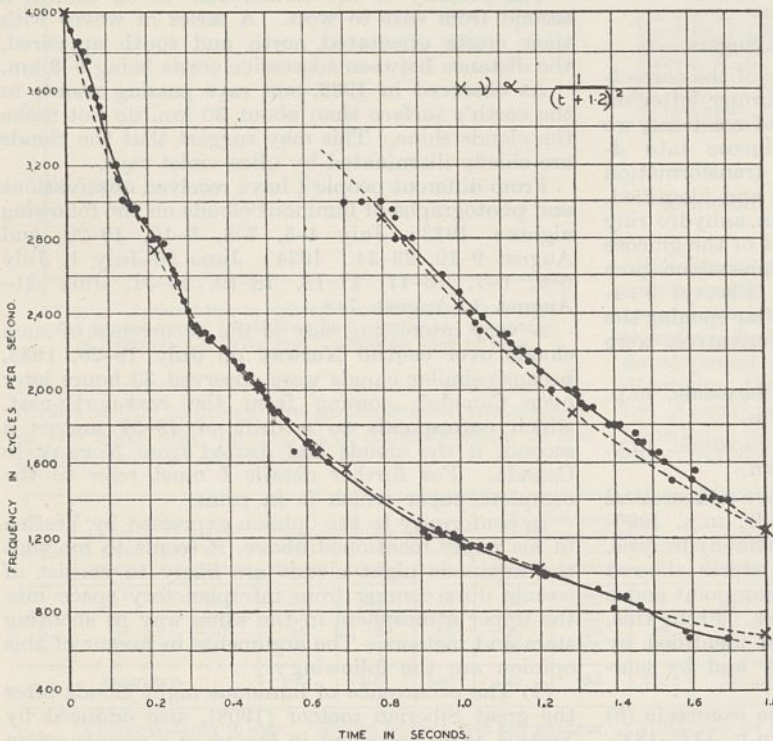


FIG. 1. Frequency curve of a 'swish pair'.

given an account of their observations in which the musical atmosphericics are considered to fall into two categories distinguished mainly by their duration and the frequency gamut covered. The short musical

atmosphericics which occur only at night time, variously christened 'tweaks' or 'chinks' lasting 1/20-1/5 sec. and covering a gamut of frequency 4,000 to nearly 1,600, can be adequately explained as the multiple reflections between the earth and ionosphere. The more interesting long-duration audio atmosphericics, variously called 'swishes', 'whistlers', *Pfeiftone*, have received no adequate explanation although many suggestions have been offered. I have maintained for some time that the effect is due to the dispersion of a pulse in the ionosphere, and a theory has been developed which accounts for the main characteristics of such audio atmosphericics.

In this theory, a pulse originating in the lower atmosphere as a lightning flash, or more probably produced in the upper atmosphere by a burst of ions from the sun, produces a spectrum of electromagnetic waves which traverse the spherical channel formed by the ionosphere and are reflected at the polar regions.

The theory supposes that it is possible that waves of such low frequency (between 400 c./sec. and 4,000 c./sec.) can traverse the densely ionised region of the ionosphere. There are two alternative theories of the dispersion in an ionised region according as the Lorentz-Hartree correction is included or not, in which the refractive index is either

$$1 - \frac{\zeta}{1 + \frac{1}{2}\zeta} \text{ or } 1 - \zeta, \text{ where } \zeta = \frac{Ne^2c^2}{\pi m \nu^2}$$

(No magnetic field.)

If the former is correct, then for frequencies less than the critical frequency ν_0 (over dense medium), $\nu_0^2 = Ne^2c^2/\pi m$, the ionosphere is completely lacking in transparency for either ordinary or extraordinary ray whatever the direction and magnitude of the earth's magnetic field. If the latter is correct, then the ionosphere is transparent to the extraordinary ray if $\nu < \nu_1 = eH/2\pi m$ and if the direction of the ray is not too nearly perpendicular to the earth's magnetic field. Clearly the theory proposed is only possible if the Lorentz-Hartree correction is neglected. A consequence of the theory is that the frequency of the whistler at any time t after the initial pulse should be proportional to $1/t^2$ so long as all the waves traverse approximately the same path irrespective of frequency.

Messrs. Burton and Boardman have obtained a record shown in Fig. 1 of the frequency of a whistler as a function of the time. The dotted curve shows the relation $\nu \propto 1/(t + 1.2)^2$, where t is the time elapsed from the observed start of the whistler. The 1.2 sec. should then represent the time between the initial pulse and the start of the musical disturbance. (The initial impulse was not audible in this case but intervals of this order are often observed.) The agreement between the theoretical and observed form is quite close.

The results may perhaps be considered as evidence (1) that the whistler is caused by the dispersion of a sudden pulse travelling through the ionosphere

(2) that the simple form of dispersion formula (without the Lorentz-Hartree correction) is correct for transmission in an unpolarised medium like the ionosphere.

This is the conclusion arrived at by Darwin² on theoretical grounds.

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Dec. 19.

¹ Barkhausen, *Phys. Z.*, **20**, 401-403; 1919. *Proc. I.R.E.*, **18**, No. 7, July 1930. Shellang, *Bell Tel. J.*, Aug. 1930. Eckersley, *Phil. Mag.*, **49**, 1250; 1925. *NATURE*, **122**, 768; 1928. Burton, *NATURE*, **126**, 55; 1930. Barton and Boardman, *Bell. Tel. J.*, **12**, 498-516; 1933.

² Darwin, *NATURE*, **133**, 62; 1934.

Over-Potential of the Hydrogen Isotopes

ALTHOUGH the separation of the two hydrogen isotopes which occurs on electrolysis must be closely connected with their over-potentials, no measurement of these has been published. A comparison of the deuterium over-potential with that of hydrogen can be of value in elucidating the general mechanism of hydrogen over-potential itself and, as part of an experimental investigation of this, measurements have been made on deuterium. In order to eliminate errors due to the resistance of the electrolyte and to violent gas evolution, it is essential that very low current densities should be used, and the electrolyte must be free from traces of oxygen or dissolved impurities. The over-potential measurements were made under conditions similar to those described in earlier papers¹, but it was a matter of some experimental difficulty to realise these with the small quantities of electrolyte available (1 c.c.). The results obtained with a mercury cathode in a 0.2 N sulphuric acid electrolyte are shown in Fig. 1.

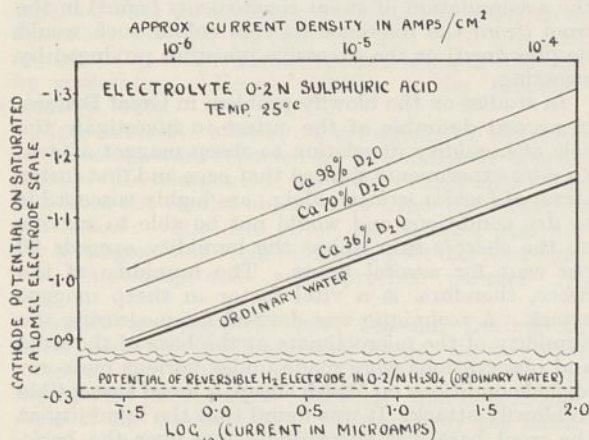


FIG. 1.

It is apparent that both isotopes give the same linear relation between current density and over-potential, and that the slope of the line is nearly the same in each case² ($\alpha = -2.3 RT \log i/dV =$ about 0.5). The irreversible potential of the deuterium is, however, considerably higher than that of hydrogen (c. 0.13 volts more negative). For 100 per cent heavy water the difference would be slightly greater. (The over-potential is, strictly, the potential difference between an irreversible electrode and a reversible electrode working in the same electrolyte. Measurements made in this laboratory by Dr. K. E. Grew

show, however, that the potential difference between a reversible deuterium electrode and a reversible hydrogen electrode is small.)

From these measurements it is clear that the over-potential difference between the isotopes is sufficiently great to explain the separation which occurs on electrolysis. From the curves we may calculate a possible separation factor under these optimum conditions. For example, at a cathode potential of -1.05 volts sat. cal.

$$\frac{\text{the rate of evolution of H}_2 = 9.23 \times 10^{-6} \text{ amp.}}{\text{the rate of evolution of D}_2 = 0.668 \times 10^{-6} \text{ amp.}} = \frac{13.8}{1}$$

We have also measured the temperature coefficient of the deuterium over-potential and find that it is greater than for hydrogen, showing that the efficiency of separation will decrease as the temperature increases.

As would be expected, the actual separation factor observed during the preparation of heavy water is considerably less than the possible one suggested above. (It varies from c. 3 at a reversible electrode to c. 8^{3,4}.) Under the usual conditions of electrolysis, there are many factors such as high current density, high local temperature, concentration polarisation, low over-potential properties of the electrode surface, interchange, etc., all of which tend to lower the efficiency. The bearing of these results on the mechanism of over-potential will be discussed elsewhere.

It is with much pleasure that we express our thanks to Drs. A. and L. Farkas for analysing the heavy water and to Imperial Chemical Industries, Ltd., for a grant.

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Cambridge.
Nov. 27.

¹ Bowden, *Proc. Roy. Soc.*, A, **125**, 446; 1929.

² Bowden, *Proc. Roy. Soc.*, A, **126**, 108; 1929.

³ Farkas and Farkas, *Proc. Roy. Soc.*, A, **146**, 623; 1934.

⁴ Eyring and Topley, *J. Chem Phys.*, **2**, 217; 1934. Bell and Wolfenden, *NATURE*, **133**, 25; 1934.

Fundamental Dimensions of μ_0 and K_0 in Electrical Science

THE recent work of committees both national and international upon the fundamental units and definitions in electrical science has shown that a considerable further step in advance, by removing difficulties, would result from the discovery of the dimensions of μ_0 and K_0 , the magnetic permeability and electric permittivity or specific inductive capacity of the medium. Some writers have recommended that the dimensions of one of these should be chosen arbitrarily in order to get this simplification, the result of which would be that the difference in physical dimensions of the various quantities, when measured in electrostatic and electromagnetic units, would disappear. Difference in size of unit causes no confusion, but the difference in dimensions due to changing the scale of measurement has been a great cause of confusion.

Electrical science is based fundamentally upon the definitions of quantity of electricity e , magnetic pole m and electric current i . The definitions of these three quantities are given by the three equations:

$$\begin{aligned} \text{force} &= ee'/K_0 r^2 \dots (1) & \text{force} &= mm'/\mu_0 r^2 \dots (2) \\ & & \text{and } i &= de/dt \dots (3). \end{aligned}$$

In these equations, μ_0 and K_0 are dimensional constants the numerical value of which would depend upon the units of measurement, but their physical dimensions depend solely upon the medium. In the historical development, i is, again, defined electro-dynamically either by the action of a current upon a magnetic pole or upon another current, and the two systems of units are thus introduced with their different dimensions for each quantity.

I am only concerned with the physical dimensions and not with the sizes of the units. Let us assume that the symbols used contain their own units, just as is common practice in dynamics. We have already defined i , and therefore there is no necessity to introduce another definition for it.

Ampère's fundamental equation in electro-dynamics is given by:

$$\text{force} = ii' ds ds' (1.5 \cos \theta \cos \theta' - \cos \varepsilon) / A' r^2 \dots (4),$$

representing the force between the elements ds, ds' , distance r apart, carrying currents i, i' ; θ, θ' and ε being respectively the angles between the elements and r and between the elements themselves, and A' is a dimensional constant. Having already defined i , let us take this as an empirical equation.

Maxwell states as a fact that an electric circuit is equivalent to a magnetic shell bounded by the circuit, a discovery which he ascribes to Ampère. The physical meaning of this equivalence is explained by modern electronic theory, which ascribes all magnetic phenomena to the electronic orbits in the atoms, thus reviving a suggestion of Ampère's in 1820 that all magnetic phenomena might be due to electric currents round the particles of matter. The molecular magnets of Ewing's useful theory are also thus accounted for.

The interpretation to be attached to the meaning of the word *equivalent* has a most important effect upon the science. The interpretation adopted by standard practice is contained in the equation $mL = \mu_0 iL^2$, corresponding to the magnetic flux being μ_0 times the magneto-motive force, or the current circuit and the magnetic shell are considered as cause and effect connected by the modulus μ_0 . This interpretation leads to the present system having dual dimensions for each quantity, connected by $c^2 \mu_0 K_0 = 1$.

I submit that, in the light of electronic theory, another interpretation of the phenomena and of the meaning of the word *equivalent*, is that the magnetic flux is part and parcel of the current and is only another partial aspect of the phenomena; and, just as in vortex motion we speak either of the vortex or its core, so in electromagnetism we may speak either of the magnetic flux or of its core i . The result of such an interpretation is that each ampere turn of magneto-motive force produces its quantum of flux just like the equivalent magnetic shell given by $mL \equiv iL^2$, and that all magnetic phenomena without exception may be regarded as the vector sum of all the magnetic shells due to all externally applied magneto-motive forces, together with those due to internal magneto-motive forces arising from the polarisation of the electronic orbits in iron or other magnetic material.

The consequence of this interpretation is that the only permeability is that of vacuum, and it has no dimensions because of the equivalence. In dealing with circuits containing iron, however, it is immaterial whether the increased flux be ascribed numerically to increased magneto-motive forces or to increased

permeability, hence the variable μ may be retained but always as a numeric.

We can deduce from the fact that $\mu_0 = 1$, that $c^2 = 1/K_0$ and also that the electrostatic system of dimensions disappears, but let us develop this result more slowly.

A consequence of all magnetic phenomena being electromagnetic is that equation (2) becomes a particular integral of equation (4), whence $mm'/\mu_0 = ii'L^2/A'$, and if $m \equiv iL, A' = \mu_0 = 1$. From equations (1) to (4), $e^2/K_0 = m^2/\mu_0 = e^2V^2/A'$, and if $A' = \mu_0 = 1$, then $e^2/m^2 = K_0 = 1/V^2$. The velocity of electromagnetic waves derived from equations (1) to (4) is given by $c^2 = A'/\mu_0 K_0 = 1/K_0$ which agrees with Maxwell's electromagnetic system, since μ_0 is a numeric in that system.

The result of the simple assumption that all magnetic phenomena are in fact electromagnetic and that Faraday's equivalence between an electric circuit and a magnetic shell is a real equivalence, in the sense of being synonymous, or different aspects of the same phenomena, is that electrical science is reduced to a singular system of dimensional quantities agreeing with Maxwell's electromagnetic system, and the electrostatic system disappears. The numerical values of the units of course remain unaltered.

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Humidity in Relation to Sheep Blowfly Attack

IN a recent letter to NATURE¹, Holdaway and Mulhearn conclude that (in Australia) "there is a relation between sweat content and susceptibility to weather stain and body strike" by blowflies. It is not clear whether they regard the predisposing factor to be the accumulation of sweat constituents (suint) in the wool (from the reference to yolk colour such would be presumed) or the excessive moisture produced by sweating.

In studies on the blowfly problem in Great Britain, it seemed desirable at the outset to investigate the rôle of humidity in relation to sheep maggot attack. *In vitro* experiments showed that eggs and first instar larvæ of *Lucilia sericata*, Meig., are highly susceptible to dry conditions and would not be able to survive on the sheep's skin unless the humidity exceeds 90 per cent for several hours. The humidity of the fleece, therefore, is a vital factor in sheep maggot attack. A technique was devised for measuring the humidity of the microclimate at the base of the wool and observations were made under various meteorological conditions on Welsh sheep, a breed susceptible to blowfly attack. It was found that the humidity at the wool base was surprisingly low over the back, ranging from 38 to 78 per cent but seldom exceeding 70 per cent even in showery conditions. However, in the region of the breech, the humidity was often high owing to the soiling of the wool with fæces or urine; this is the site of the majority of attacks in this country. It can be concluded that normally the humidity at the base of the wool is too low for the development of larvæ of *Lucilia sericata*. This was confirmed by placing eggs and young larvæ on sheep, when myiasis did not result unless the wool was kept wet by frequent watering. Also, we have on several occasions found desiccated eggs and larvæ on sheep in the field.

In Australia among Merinos, body strike is

associated with an infectious condition of the wool producing "weather stain" and it is prevalent following "excessive rains and humid conditions generally". Attacks on the back are not uncommon in this country; in fact, they were especially prevalent in North Wales during the dry summers of 1933 and 1934, infestation usually beginning in the region between the shoulder-blades. Clearly, the humidity at this spot must sometimes become abnormally high, perhaps owing to excessive sweating. The humidity at the wool base was occasionally found to be higher in this region than elsewhere on the back.

We have, therefore, concluded that in Great Britain, whether faeces, urine or sweat be responsible, it is the moisture in each instance which permits the establishment of sheep maggots.

These results will shortly be published in detail elsewhere.

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¹ NATURE, 134, 813, Nov. 24, 1934.

Mutations and the Ageing of Seeds

M. NAVASHIN¹ and his co-workers reported in a series of papers that plants produced from old seeds in *Crepis* show a great percentage of 'mutations'. Similar observations were reported by Cartledge and Blakeslee² and by Peto³ in America working with various plants. They confirmed the results found by Navashin and his co-workers. All these authors state that Navashin made this discovery. Hugo de Vries, however, in his "Mutationstheorie" (1901)⁴, reported that in one case five-year old seeds from *Oenothera* gave 40 per cent instead of 5 per cent mutations (p. 185). He interpreted this phenomenon by postulating a longer viability of the 'mutated' seeds (p. 186).

More extensive studies on the ageing of the seeds in *Oenothera* were reported by Nils Heribert Nilsson (1931)⁵. He summarised his observations in a table and from the results obtained he drew the following conclusion: "Mit dem Alter des Samens, also mit der herabgesetzten Keimfähigkeit, geht das Ansteigen des Mutationsprozent ausgesprochen parallel" (p. 326).

Recent investigations (see, Cleland, Darlington, Gates, Renner, Oehlkers, and others) showed that some of the mutations in *Oenothera* are due to segmental interchanges between non-homologous parts of the chromosomes. Consequently the mutations reported by H. de Vries and N. Heribert Nilsson are obviously due to chromosomal alterations. Chromosomal alterations (but not gene mutations) were reported by Navashin too, that is, Navashin confirmed cytologically the observations reported by de Vries and Heribert Nilsson.

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¹ Navashin, NATURE, 131, 436; 132, 482; 1933. *Planta* 20, 233; 1933.

² Cartledge and Blakeslee, *Science*, 78, 523; 1933. *Proc. Nat. Acad. Sci.*, 20; 1934.

³ Peto, *Canad. J. Res.*, 9, 261; 1933.

⁴ H. de Vries, "Mutationstheorie", 1901; pp. 185, 186.

⁵ Nils Heribert Nilsson, *Hereditas*, 15, 320, 326; 1931.

Vitamin B₁ and Blue Fluorescent Compounds

FLUORESCENCE in ultra-violet light (screened by Wood's glass) is not a property of vitamin B₁; but I have found that the purest preparations in our possession (method of Kinnersley, O'Brien and Peters, 1933¹) can be converted by oxidation in aqueous solution into substances showing an intense sky-blue fluorescence.

Blue fluorescent compounds are stated to arise as breakdown products of the yellow fluorescent flavins (Kuhn, *et al.*²); hence the Bence Jones 'quinoidine' substances in yeast extracts (Kinnersley, Peters and Squires³) can originate from vitamin B₁ as well as from vitamin B₂. Arising from my observation upon vitamin B₁, it seems to be possible for the first time to postulate a relation between vitamin B₁ and the pyrimidine group. In this connexion it is interesting to note that the empirical composition C₁₂H₁₆ON₄S of vitamin B₁ (Windaus *et al.*⁴, Holiday *et al.*⁵) corresponds with that of a thio-hexahydro lumichrome (lumichrome C₁₂H₁₀O₂N₄). The hydrogenation of the azine or benzene rings may account for the strength of the vitamin as a base and for its high water solubility.

The several lines of investigation thus indicated are being actively pursued by ourselves and colleagues, though it is admittedly difficult to reconcile our working hypothesis with the formation of the particular degradation products of vitamin B₁ recently described by Windaus, Tschesche and Gröwe⁶. So far, it has not been found possible to replace vitamin B₁ with flavin in the specific respiration of avitaminous brain tissue, which is catalysed by vitamin B₁⁷.

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Dec. 23.

¹ *Biochem. J.*, 27, 232; 1933.

² Kuhn, Rudy and Wagner-Jauregg, *Ber. deut. chem. Ges.*, 66, 1950; 1933. See also Stern and Holiday, *Ber.*, 67, 1442, and Karrer Salomon, Schopf, Schlittler and Fritsch, *Helvet. Chem. Acta*, 17, 1010; 1934.

³ *Biochem. J.*, 19, 404; 1925. See also von Euler and Adler, *Z. physiol. Chem.*, 228, 1; 1934.

⁴ Windaus, Tschesche and Ruhkopf, *Nach. Ges. Wissen. Göttingen*, 111, 343; 1932.

⁵ Holiday, Kinnersley, O'Brien and Peters, *J. Soc. Chem. Ind.*, 53, 1024; 1934.

⁶ Windaus, Tschesche and Gröwe, *Z. physiol. Chem.*, 228, 27; 1934.

⁷ Passmore, Peters and Sinclair, *Biochem. J.*, 27, 843; 1933.

Testing for Unconsciousness After an Electric Shock

It has been definitely proved that the tests of consciousness used in chloroform anaesthesia cannot safely be assumed to be valid in the case of an animal or person who has been immobilised as a result of an electric stimulation of the brain. The matter is of great importance because, as a result of the Slaughter of Animals Act, electric immobilisation is being extensively used in the slaughter-house as an alleged anaesthetic; and its use for operations, both veterinary and experimental, has been proposed.

The object of this letter is to point out that there exists a strong tendency to stifle inquiry into this unsettled question, and to discourage further investigation by making statements which imply that electrolethalling has been proved to cause genuine anaesthesia. It is not difficult to explain this tendency to brush aside unsettled questions, for there are strong motives for desiring to believe that electrolethalling, as practised in the slaughter-house, is humane. Moreover, vested interests have grown up around the practice, and humanitarians who have

prematurely endorsed it are reluctant to believe that their judgment may have been wrong.

Many wild theories have been put forward with the object of explaining the observed phenomena in accordance with the wishes of those who propound them, and objective data on the subject are extremely restricted in their scope. The following facts appear, however, to be established:—

(1) It is possible to produce, by passing a suitable electric current through the brain, a nightmare state in which the subject retains his senses, but appears to an external observer to be completely unconscious, the pupil reflex being absent. The conditions under which this state can be produced have not been satisfactorily delimited, but they appear to approach those employed in the slaughter-house. The requisite range of conditions, whatever it may be, is one which sometimes although very rarely occurs in electrical accidents.

(2) A weak interrupted direct current produces the same objective phenomena as sinusoidal (electro-lethaller) current twenty times stronger as read with an ammeter. Thus it is found that to get the desired objective effects on pigs in the slaughter-house the sinusoidal electrolethaller current must lie roughly between half an ampere and one ampere, while Regensburger gets similar results with 10-per-cent-interrupted direct current of from 31 to 53 milliamperes.

(3) Controlled experiments on human beings have not been carried quite up to the point where the subject fails to recover his mobility immediately on the cessation of the current. In slaughter-house practice the current-strength lies just above this point, and it must have done so in the case of those rare electrical accidents in which the nightmare state persisted after the accident.

(4) Leduc submitted himself to interrupted direct current up to 4 milliamperes but failed to reach unconsciousness, although his assistants supposed him to be completely unconscious for twenty minutes. He felt sure, however, that if the current had been raised a very little higher unconsciousness would have ensued. Dr. J. Hertz, in Paris, therefore repeated the experiment on incurable invalids with currents up to 25 milliamperes (or 18 milliamperes where the on period was 10 per cent) but Leduc's prediction was not fulfilled. The subjects failed to pass beyond the nightmare state. They exhibited permanent dilation of pupils and were unable to respond to stimuli, but they retained their sensibility.

(5) Breathing was sometimes inhibited during the nightmare state in Hertz's subjects, and in some victims of electrical accidents. Zimmern in particular refers to an accident in which the victim knew that he could not breathe voluntarily and dreaded that artificial respiration might be abandoned prematurely.

(6) The muscles in Hertz's subjects were sometimes contracted and sometimes relaxed. The absence of squealing in electrolethalled pigs is not therefore necessarily due either to muscular contraction or to unconsciousness. It may, for all we know, be due simply to the nightmare state.

(7) Whether the pigs, if conscious, suffer pain from the current must depend on whether their muscles are relaxed or violently contracted. Both conditions may occur in practice.

I intend to publish before long a more detailed

statement of the above points; the purpose of the present letter is to urge that every effort should be made to encourage inquiry into an unsettled question, with regard to which we require new data based on research and not dogmatic assertions based on the will to believe.

C. W. HUME.

14, The Hawthorns,
Finchley, N.3.
Dec. 1.

Magnetism of Tin

S. RAMACHANDRA RAO has reported¹ that, on testing colloidal powders of white tin magnetically, its paramagnetic susceptibility becomes diamagnetic as the particle size decreases, this diamagnetism increasing as the particle size decreases. A few years ago we often observed the same phenomenon in the investigation of the effect of cold-working on the susceptibility of white tin. In our case we found that the paramagnetic susceptibility of white tin changes its sign as the internal stress caused by cold-working increases, this value of diamagnetism increasing in proportion to internal stress. This change of susceptibility has been explained by a slight expansion of tin by cold-working².

Thus the interesting phenomenon observed by S. R. Rao may be explained as follows. As a theoretical calculation shows, the lattice constant of a metal is somewhat larger in the surface layer than in the interior, the constant attaining gradually its normal value at some hundred layers below the surface. Hence it is to be expected that, as the particle size of tin diminishes, its mean lattice constant increases; the result of colloidalisation is therefore the same as that of cold-working. Hence we may assume that through the volume expansion due to colloidalisation of tin, its magnetic susceptibility is affected in two different ways:

(1) The decrease of paramagnetic susceptibility due to the diminution of free electrons caused by the expansion.

(2) The increase of diamagnetic susceptibility due to the increase of bound electrons caused by the expansion.

In the case of cold-working of white tin, its susceptibility is observed to change, for example, from 0.027×10^{-6} to -0.0049×10^{-6} , corresponding to a change of density by cold-working from 7.291 to 7.280. The calculated value of the susceptibility corresponding to this change of density is from 0.0270×10^{-6} to -0.0051×10^{-6} ; the agreement between the observed and theoretical values is satisfactory. It may, therefore, be concluded that the curious change of susceptibility from a positive to a negative value in the case of colloidalisation is due to the increase of the mean lattice constant due to refining of tin particles; but a quantitative comparison between the theoretical and observed values cannot be made, as the change of density caused by colloidalisation has not yet been measured.

KOTARÔ HONDA.
YOSOMATSU SHIMIZU.

Research Institute for Iron,
Steel and Other Metals,
Sendai, Japan.
Dec. 15.

¹ NATURE, 134, 288, Aug. 25, 1934.

² K. Honda and Y. Shimizu, NATURE, 132, 565; 1933. Y. Shimizu, Sci. Rep., 22, 915; 1933.

Magnetic Induction in a Supra-Conducting Lead Crystal

IN our last note¹ we showed the relation between magnetic induction and field strength in the case of a polycrystalline lead rod. We now report shortly on analogous experiments carried out with a lead single crystal.

The measurements were carried out at various temperatures with the second method that we described, the magnetic moment of the supra-conductor being determined in a constant field. One may conclude from Fig. 1, in which the results of our measurements at 4.24° K. are shown (full curve), that the destruction of supra-conductivity occurs in almost the same way in single crystals and in polycrystalline lead. The sudden rise of the induction begins almost exactly at the same critical field strength H_k as in polycrystalline material; however, in single crystals the transition region, that is, the field interval in which the transition from one state to the other begins and terminates, is considerably narrower, extending over merely 7 gauss. In the transition region, the induction is observed to rise slightly with time in a constant magnetic field.

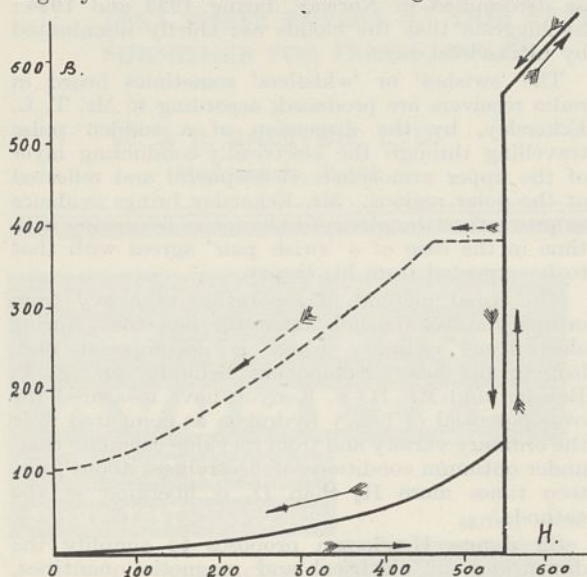


FIG. 1.

However, the reverse process, the appearance of supra-conductivity on moving from strong fields to fields less than H_k , is found to be different for single crystals and polycrystalline rods. For comparison, the dotted curve on the same figure shows the relation between B and H for polycrystalline lead. It appeared that in this transition the induction followed a change in the field strength slowly, the process depending strongly on time. The dependence on time was particularly strong in the transition region of the field strength—the same field strengths as those at which the supra-conductivity was destroyed—where even after waiting for half an hour we did not succeed in reaching a state of equilibrium, the induction still changing with noticeable velocity. As the period of our experiments was limited by the speed with which the helium evaporated, the curves which we obtained in decreasing magnetic fields do not correspond to the equilibrium state. On decreasing the field strength to zero a residual magnetisation is observed, which

in different experiments varied between 0 and 2 per cent of the maximum of B in the transition region. It was found that the residual magnetisation sank noticeably with time.

The strong dependence on time and the small hysteresis in single crystals have convinced us that all states of a supra-conductor with an induction differing from zero are unstable. These experiments again confirm the concept of two phases, an ordinary and a supra-conducting phase with an induction equal to zero. The transition from the supra-conducting to the ordinary phase occurs rapidly, whereas the reverse transition takes place more slowly. It is interesting to note that the latter process occurs so gradually that a fairly sensitive telephone in connexion with an amplifier is insufficient to detect any spontaneous changes in the induction.

G. N. RJABININ.

L. W. SHUBNIKOW.

Ukrainian Physico-technical Institute,
Kharkov.
Nov. 25.

¹ G. N. Rjabinin and L. W. Shubnikow, NATURE, 134, 286, Aug. 25, 1934.

Symbols for Chromosome Numbers

WHILE in entire agreement with Prof. Gates's view¹ that a convention should be agreed upon to distinguish between the basic and the haploid chromosome number, I am not convinced that the introduction of a new symbol is necessary. The use of x to indicate the basic number, leaving n for the haploid number, has been the standard practice in this laboratory for the last three years². In spite of Prof. Gates's fears, no confusion seems to arise from its use. I may also point out that a Greek letter has the grave practical disadvantage of being troublesome to print and impossible to type on an ordinary machine.

BRENHILDA SCHAFER,
Librarian.

John Innes Horticultural Institution,
Merton Park, London, S.W.19.

Jan. 1.

¹ NATURE, 134, 1011, Dec. 29, 1934.

² See Darlington, "Recent Advances in Cytology", p. 61 (1932); Sansome and Philip, "Recent Advances in Plant Genetics", p. 165 (1932); and Crane and Lawrence, "The Genetics of Garden Plants", p. 28 (1934).

Publication of *Nomina Nuda*

WE wish to support the appeal of Sir Sidney Harmer in NATURE of December 22 (p. 973) for the suppression of *nomina nuda* by editors of scientific publications.

Editors, however, cannot always be expected to recognise the character of names which, like the one that has caused Sir Sidney Harmer's protest, may perhaps be called *nomina seminuda*. We would further appeal, therefore, to writers of zoological papers to avoid using names that are not formally introduced according to the rules of zoological nomenclature.

C. TATE REGAN, N. D. RILEY,
Director. Keeper of Entomology.
W. T. CALMAN, W. D. LANG,
Keeper of Zoology. Keeper of Geology.

British Museum (Natural History),
London, S.W.7.

Jan. 7.

Points from Foregoing Letters

X-RAY investigation of thin films of myosin, the protein substance of the muscle, by Mr. W. T. Astbury and Mrs. Sylvia Dickinson, shows that this substance, when stretched, behaves very much like α -keratin, which is derived from hair. Keratin differs from myosin mainly in containing the sulphur compound, cystine: the authors raise the question whether hair might not be considered as 'vulcanised' muscle.

Prof. G. Hevesy points out that, while the isotopes of potassium of atomic weight 40 or 41 may be responsible for its radioactivity, there still remains the difficulty of reconciling the computed long life of these isotopes with the half-million volt energy of the electrons emitted by potassium. Prof. F. H. Newman and Mr. H. J. Walke suggest that the radioactivity of potassium may be due to extremely small amounts of an isotope of weight 40 hitherto undetected, which may have arisen from the action of neutrons upon the abundant calcium isotope of the same atomic weight.

Copper and lead—though of greatly different atomic number (29 and 82)—are found by Dr. Giulia Alocco to absorb the more penetrating cosmic particles to the same extent. The softer cosmic shower-producing 'radiation' is unequally absorbed by substances of different atomic number.

Certain irregular variations with time in the amounts of cosmic rays are found by Prof. V. F. Hess and Dr. W. Illing to be due mainly to the softer components and to be related to variations, in the opposite sense, in the horizontal component of the earth's magnetic field.

Dr. Leo Szilard and Mr. T. A. Chalmers report that the heavy element indium, when bombarded with neutrons, yields radioactive substances of three different life periods. Since indium has only two known isotopes (113 and 115), one of them must be activated with two periods. This had been observed previously only with light elements.

The radioactivation of iodine by means of neutrons liberated from heavy water by the gamma-rays of radium is reported by Dr. T. E. Banks, Mr. T. A. Chalmers and Prof. F. L. Hopwood. This raises interesting questions concerning atomic transmutations that might be brought about within the living body.

The ordinary hydrogen molecule (H_2) is the simplest known molecule, and the first task of any physical theory that aims at explaining the nature of matter is to account for its structure, as indicated by its spectrum. Prof. O. W. Richardson reports several new systems of bands in the H_2 spectrum, and discusses the electronic configuration that might account for them.

Europium bichloride gives in ultra-violet light a brilliant purplish-pink fluorescence, the spectrum of which contains a broad band in the blue, identical with that given by fluorite under the same condition. This is considered by Dr. K. Przibram as additional evidence that the blue fluorescence of fluor spar in ultra-violet light is due to the presence in that mineral of the rare element europium, in the form of a bivalent salt.

In the spectrum of the light scattered by liquids (Raman effect) two 'wings' of continuous light usually appear at the sides of the primary line.

Dr. E. Gross and Mr. M. Vuks bring evidence from the light-scattering behaviour of diphenyl ether to show that these 'wings' are not due to the rotation of the molecules, as usually assumed, but to the vibrational Raman effect.

Synthetically produced auxin, the hormone responsible for growth by the elongation of the cells, is found by Dr. K. V. Thimann and Mr. J. B. Koepfli to be also fully active in promoting root-formation on pea-cuttings. From this they deduce that the growth-promoting and root-forming substances of plants are identical.

From the rate at which eyes are regenerated in decapitated (well-fed but previously starved) flat-worms (*Dendrocoelum*), Dr. A. A. Wolsky deduces that starvation reduces the amount of formative material available for regeneration.

Cosmic dust coming from inter-planetary space is probably responsible for the luminous night-clouds observed in Norway and Canada. Prof. Carl Störmer gives particulars of their height (82 km.) and velocity, as determined in Norway during 1933 and 1934; he suggests that the clouds are chiefly illuminated by ultra-violet rays.

The 'swishes' or 'whistlers' sometimes heard in radio receivers are produced, according to Mr. T. L. Eckersley, by the dispersion of a sudden pulse travelling through the electrically-conducting layer of the upper atmosphere (ionosphere) and reflected at the polar regions. Mr. Eckersley brings evidence to prove that the observed change in frequency with time in the case of a 'swish pair' agrees with that to be expected from his theory.

The usual method of separation of heavy from ordinary water depends upon the fact that, during electrolysis, ordinary water is decomposed first, leaving the heavy component behind. Dr. F. P. Bowden and Mr. H. F. Kenyon have measured the over-potential of heavy hydrogen as compared with the ordinary variety and from its value calculate that, under optimum conditions of electrolysis, about fourteen times more H_2 than D_2 is liberated at the cathode.

Sir James Henderson proposes to simplify the dimensions of electrical and magnetic quantities, basing his suggestions on the view that all magnetic phenomena are due to electronic motion. He postulates that the only permeability is that of vacuum and that it has no dimensions. This makes $\mu_0 = 1$ and $K_0 = 1/c^2$, so that the electrostatic system of dimensions disappears.

A sky-blue fluorescence in ultra-violet light is developed, upon oxidation, in the anti-beriberi vitamin (B_1). Prof. R. A. Peters reports this change and indicates its bearings on the, as yet undetermined, chemical constitution of vitamin B_1 .

The change in the magnetic susceptibility of white tin from para- to diamagnetic when it is reduced to a colloidal powder, as observed by Dr. S. R. Rao, is analogous to the same magnetic change produced by cold working, according to Prof. K. Honda and Dr. Y. Shimizu. These authors explain both phenomena as due to the different atomic arrangement in the surface layers from that in the interior, the lattice constant being larger in the surface layer.



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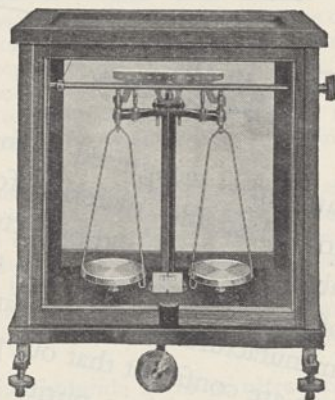
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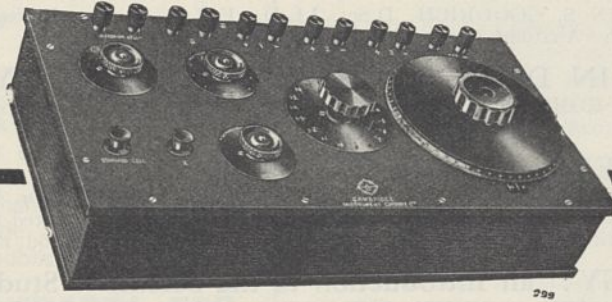
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Edison Medal Award

THE Edison Medal for 1934 has been awarded by the American Institute of Electrical Engineers to Prof. Willis R. Whitney, "for his contributions to electrical science, his pioneer inventions, and his inspiring leadership in research". The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by the American Institute of Electrical Engineers. Prof. Whitney has been vice-president in general charge of research of the General Electric Company, Schenectady, New York, since 1932.

Equivalence of Energy and Inertial Mass

ON December 28, during the meeting at Pittsburgh of the American Association for the Advancement of Science, Prof. A. Einstein delivered the Josiah Willard Gibbs Lecture of the American Mathematical Society. The accompanying summary was provided by Prof. Einstein for the use of Science Service: "It is well known that the equivalence between energy and inertial mass is one of the most important consequences of the special theory of relativity; this principle forms at present a useful tool of research in the physics of atomic nuclei. The theoretical derivation of this principle of equivalence, while restricting myself to what is conceptually necessary, is the subject of my lecture. From the Lorentz transformation and the assumption of the impulse and energy principle for material particles, the form of the impulse and energy of the moving particles, as well as the equality of mass and rest-energy, is derived. The whole proof is based on the consideration of an elastic and an inelastic collision between two identically constituted material particles."

Limits of Industrial Employment

DR. E. C. SNOW, in a paper read before the Royal Statistical Society on January 15, discussed "The Limits of Industrial Employment—the Influence of Growth of Population on the Development of Industry". The first part of the paper dealt in con-

siderable detail with the facts of growth of population in the nineteenth century and up to the outbreak of War. During a considerable part of that period, the population of England and Wales was increasing at the rate of 300,000–350,000 per annum—entirely due to the decline in the death rate. This decline in mortality was not peculiar to industrialised Great Britain, but was equally marked in other agricultural countries. The analysis of the statistical evidence seems to justify the view that the growth of industry in Great Britain was not the direct cause of the increase in population. The population circumstances of England and Wales at the present time are widely different from those ruling up to the time of the War. The population at ages under thirty-five years is declining. At ages over sixty it is still increasing, but the net effect is an annual increase of population of not more than a quarter of that before the War. The economic effect of the smaller rate of population growth now is indicated by the fact that the quantity of foodstuffs imported since 1924 has increased at less than 1 per cent per annum. The overseas countries which rely on this market for an outlet for a large part of their production of foodstuffs are living in the expectation that Great Britain can increase its imports of food at the old rate of 5 per cent per annum, whereas, in fact, it has for some time only been increasing at the rate of 1 per cent per annum, and before long even this small rate of increase is likely to decline.

Russian Academy of Sciences

THE recent decision of the Soviet Government to transfer the Russian Academy of Sciences and its affiliated institutions from Leningrad to Moscow marks the beginning of a new period in the history of the Academy, which dates back more than two hundred years. As is pointed out in the *Izvestia*, the transference is not a measure dictated merely by consideration of convenience. Indeed, the accommodation which has to be provided at short notice for more than a hundred institutes, laboratories, museums, etc., forming the Academy is only obtainable in the already overcrowded Moscow mainly at the expense of other institutions, which are being moved elsewhere. New and spacious buildings are being erected at a 'shock speed', but mostly just planned, while many of the institutions are actually moving. In addition, living quarters have to be provided for the thousands of academic officials and their families, since all flats, rooms, etc. in Moscow are under the strictest State control. All these difficulties have resulted from the recent decree by which the Academy has been brought under the direct control of the Soviet of the People's Commissars. New statutes for the Academy are being prepared in order to replace "the old traditions of purely academic outlook" by work on problems connected with the "socialistic reconstruction" of the country. While the new order will possibly mean increased material support for some of the academic institutions, the decision as to whether or not a certain branch of abstract research deserves support will apparently be now in the hands of laymen officials.

Association of British Zoologists

THE annual meeting of the Association of British Zoologists was held on January 5, in the rooms of the Zoological Society in Regent's Park, under the presidency of Prof. F. Balfour Browne. The morning session was given to a discussion of the general trends of zoological science at the present time. In opening the discussion, Prof. D. M. S. Watson defined zoology as the science of animal life in all its aspects. He emphasised the recent tendency of zoology to return from the strictly taxonomic and morphological outlook of the latter part of the last century to the more biological outlook of pre-Darwinian zoologists. He concluded that the reason for this tendency, in spite of the undeniable importance of a knowledge of comparative morphology for all branches of zoology, is that the time is now past when important alterations in our conceptions of morphology are likely to occur. He thinks that the greatest need to-day is a wider knowledge of the animal as a living thing, and of those branches of zoology, such as comparative physiology, embryology and genetics, on which knowledge of animal life must rest. In recent years this need has been brought even more clearly to the front by the great extension of the economic applications of zoology.

IN the discussion which followed, there was almost complete agreement with Prof. Watson both in his definition of zoology, and in the emphasis which he laid on the development of zoology as the study of the living animal. Dr. J. Gray dwelt on the need for teachers to treat the animal as a living thing. In the past, and still to a large extent to-day, zoological teaching has, he thinks, failed to give a broad picture of animal life: to repair this failure is its most pressing need. In comparative physiology, which provides a large proportion of the essential knowledge for the science of animal life, the aims of the zoologist are similar to those of the medical physiologist, and he must follow similar methods. Dr. E. S. Russell agreed with earlier speakers in regarding zoology as the science of animal life, and stressed the necessity in such a science of returning to the earlier conception of the animal as an organism and discarding the analytical outlook which originated with the development of the cell theory. Prof. E. W. MacBride also accepted the study of animal life as a definition of the aim of zoology. He emphasised the importance of habit in the life and evolution of animals and therefore in zoological science. In the afternoon, several members of the association demonstrated applications of photographic methods to biological research. Mr. F. S. J. Hollick described an apparatus for recording the movements of insect wings in flight and the air currents set up by their movements, while Mr. A. G. Lowndes gave an account of his most recent methods of photographing the movements of small animals by means of an instrument in which the stroboscope and cinematograph are combined.

Cancer Research

AT the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on January

14, the following additional grants for 1935 were approved:—£200 to Dr. Ralston Paterson for the part-time services of a radiologist at the Holt Radium Institute, Manchester; £250 to the Strangeways Research Laboratory, Cambridge, for the services of Dr. A. Glucksmann; £200 to Dr. Edith Paterson, at Manchester and £1,000 to the Radium Beam Therapy Research for the salary of qualified research workers. The Scientific Advisory Committee has been allotted a sum of £500 for the year 1935 for the salary and expenses of a research worker to carry out, under its supervision, an investigation of the action of radiation on colloids. The National Cancer Association of South Africa, which is representative of the research organisations of the Cape, Transvaal, Natal and Orange Free State, has been approved as a body affiliated to the British Empire Cancer Campaign. The Ottawa correspondent of *The Times* states that Canada will commemorate the twenty-fifth anniversary of the accession of King George to the throne by establishing a national fund for a campaign against cancer in Canada.

Decreasing the Number of Motor Accidents due to Skidding

CONCLUSIONS on this topic arrived at by Prof. R. A. Moyer, of Iowa State College, as set out in a paper read to the Highway Research Board, have been reported by Science Service, Washington, D.C. An exhaustive study of the skidding characteristics of motor-car tyres on various types of road surface indicates that the most important anti-skidding factor on the highway is to cover its surface with gritty particles so that it acts like sand-paper. The marked increase in the speed of vehicles on highways has led to a serious problem. The coefficients of friction between road surfaces and rubber tyres become smaller as the speed increases, and so skidding becomes easier. All stopping distances and centrifugal forces on curves increase as the square of the speed; that is, if the speed is doubled the shortest possible distance for stopping is increased four times and the necessary road friction is also increased four times. Highway engineers have been considering the possibility of building curves in spiral transmission fashion when the speed exceeds fifty miles an hour. In fast driving, in order to negotiate curves, the driver finds it easier to move from one side of the road to the other, but on blind curves this is a danger to approaching cars. Engineers are considering the possibility of building curved roads of such a shape that this tendency of drivers of fast cars may cease to be a menace to cars coming in the opposite direction. Prof. Moyer also points out that the application of the brakes when the car is going round a curve increases the tendency to skidding sideways but that the application of power decreases this tendency. For uniform braking the distribution of the load should be such that more weight falls on the back wheels than on the front wheels.

Position of the American Negro

RACIAL unity, racial pride and racial traditions have been of late subjects of discussions in which

passion and prejudice have been more conspicuous than exact knowledge. From Vanderbilt University, Nashville, Tennessee, one of the smaller privately controlled universities of the United States, we have received a volume of abstracts of theses presented during 1933-34 by candidates for advanced degrees and, among them, a study by a candidate for the doctorate of philosophy of a movement for fostering these elements of culture among a 'non-Aryan' group, namely, the American Negro. It seems that since towards the close of the nineteenth century a sustained effort to develop race-conscious feeling so as to achieve "the internal unity and sentimental solidarity necessary to give the race a life more or less separate from other groups" has accompanied a vigorous struggle for recognition and status. Especially in the five years 1910-15, the aims and purposes of the movement became definitely established, a recognised leader emerged and formal machinery for its further promotion was created. At the present time, extensive provision is made by Negro colleges and universities for courses of instruction in Negro life and history, and numerous activities have developed outside the class-room designed to make students better acquainted with Negro tradition: pageants depicting Negro progress and achievement, essay competitions, the celebration of Negro History Week, exhibitions of Negro art and literature and music festivals featuring Negro folk music. By making his history and tradition extensively known outside the community, it is assumed that the Negro will gain a larger measure of recognition and respect from the world at large for his worth and capacity.

History and Uses of Paraffin Wax

In his paper read before the Institution of Petroleum Technologists on December 11, 1934, on the "Utilization of Paraffin Wax and Petroleum Ceresin", Mr. P. G. Higgs outlined the history of petroleum wax from its discovery in 1830 to its production on a commercial scale. Its use for a long time was restricted, since combustibility alone of all its useful properties was universally acknowledged as of market value. Time has shown, however, that paraffin wax can be used in cases where its characteristics of resistance to water, inertness, good electrical properties, etc., are invaluable. Thus to-day, apart from its chief function as an illuminant, it is employed, for example, as a proofing agent for porous materials, in the manufacture of waxed paper and paper boards, as an external coating to wooden receptacles for the preservation of foodstuffs, as an ingredient of polishes and in the electrical industry for insulating purposes. In addition, it is used in the form of an aqueous emulsion in the sizing of paper, as a size in the weaving of cotton, and as a glossing agent in the laundry trade.

PETROLEUM ceresins, the most recent addition to the range of paraffin waxes, are characterised by a relatively high setting point and micro-crystalline structure. Experiments have shown that the addition of 0.3 per cent or less to commercial paraffin wax alters the structure of the whole practically to micro-

crystallinity. Moreover, in the case of candles made from paraffin wax to which a similar small percentage of ceresin has been added, resistance to bending is substantially increased. Initially, the strong colour of petroleum ceresin was a disadvantage in this connexion, but this is overcome by incorporation of the ceresin during the manufacture of the paraffin wax and refining the two together. The resultant product, while having a pleasing colour, also lacks, or has in a much lesser degree, the defects usually consequent on marked crystallinity of the paraffin wax. It is reasonable to suppose, therefore, that the usefulness of paraffin wax could be still further extended by the addition of small quantities of petroleum ceresin. Whether it is better to manufacture 'doped' waxes or leave the 'doping' process to the user is, however, still an open question.

Water Purification by Ozone

In *Engineering* of January 4, Mr. T. Rich gives an account of the development of the treatment of water by ozone which has resulted from the researches made by P. Otto in 1898 in connexion with his thesis for a doctor's degree at the Sorbonne. When Dr. Otto was carrying out his experiments, the question of potable water supplies in France was becoming a matter of concern, and, encouraged by Pasteur, he took up the design of ozone water-sterilisation apparatus for outputs varying from that through a single tap to that required for large cities. One of the first important installations laid down to his designs was that for Nice, and since this was constructed many other places on the Riviera have followed the example of Nice, owing to serious outbreaks of typhoid. In 1932, the scientific commission for the study and control of the water supply of Paris decided to supersede the use of chlorine by the use of ozone for treating water taken from the Seine and the Marne, while quite recently an important ozone-sterilisation plant has been put into commission for the water supply of Nancy, a manufacturing city of 120,000 inhabitants. There are other plants in operation in Belgium, Italy, Rumania and on the Congo, and the system has been applied to the water supply of large passenger vessels. The principal apparatus in a plant is the electrically-worked Otto ozone generator, and of this Mr. Rich gives a full description.

Grey and Red Squirrels in England

In the report on animal numbers, issued by the Oxford University Bureau of Animal Population at the end of 1934, the director, Mr. A. D. Middleton, states that the evidence from the Bureau's three hundred or so observers in various parts of Great Britain points to another serious increase of the American or Carolina grey squirrel (*Sciurus carolinensis*, Gmelin) and also an increase of the native British red squirrel (*Sciurus leucourus*, Kerr) after the setback due to disease outbreaks of a species of *Eimeria* (Coccidia) noted in 1931. During the last three years, the report points out, the British red squirrel seems to have been steadily regaining

its former status in most parts of the country and is now commonly seen in many districts where the American grey squirrel is not present. Even within the area occupied by the grey squirrel, red squirrels have frequently been seen during the past two years. The American grey squirrel, after its severe setback in 1931, due mainly to disease, was in comparatively low numbers during 1932 and 1933, but there are now many indications that a period of increase is well on the way. It has gradually extended its range, spreading outwards from the main areas previously occupied (home counties, Midlands, Central Yorkshire, Cheshire, North Wales, Dumbartonshire, Fife and the environs of Bournemouth, Exeter and Edinburgh); several have been found in an isolated wood near Woodbridge, in Suffolk. "Should the numbers increase greatly over this large area," adds Mr. Middleton, "it seems probable that the grey squirrel may become of more serious economic importance than hitherto." The Oxford University Bureau is now extending its national investigations of animal numbers to the Japanese deer (*Cervus sika*) which have escaped from many English parks and taken to living wild in the woods of the home counties and the south, and of harvest-bugs (*Trombididae*).

Scientific Correspondence of Sir James Smith (1759-1828)

THE main portion of Part 1 of the Catalogue of Manuscripts in the Library of the Linnean Society of London is devoted to the scientific correspondence of the first president of the Linnean Society, and Mr. Warren Dawson has abstracted the more important matters referred to in more than 3,000 letters received by Sir James Edward Smith (1759-1828) (Catalogue of the Manuscripts in the Library of the Linnean Society of London, Part 1. The Smith Papers. The Correspondence and Miscellaneous Papers of Sir James Edward Smith, M.D., F.R.S., First President of the Society. By Warren R. Dawson, F.R.S.E. Pp. 114. London: The Linnean Society, 1934. 10s. net). It is a careful piece of work, the completion of which confers a benefit on all who are interested in the natural history of the period immediately following Linnæus's death, and the transference of his collections to England six years later. The correspondents include many distinguished naturalists both at home and abroad, and some of their letters are valuable documents from the point of view of the history of biology. Sir James Edward Smith was primarily a botanist, but as possessor of Linnæus's collections for about forty-five years he had wide interests as a naturalist. He was one of the founders of the Linnean Society of London, his co-founders being the Rev. Samuel Goodenough, afterwards Bishop of Carlisle, and Thomas Marsham, an entomologist.

International Aspects of Drug Addiction

IN the Norman Kerr Memorial Lecture on this subject published in the January issue of the *British Journal of Inebriety*, Sir Malcolm Delevingne, late Deputy Permanent Under-Secretary of State and

British representative on the Opium Advisory Committee of the League of Nations, showed that the international treatment of the problem during the last fourteen years has afforded a striking example of what can be accomplished in a difficult field by international co-operation, aided by the machinery of the League of Nations. After a historical sketch of the subject with special reference to the conferences at the Hague and Geneva, he dealt with the present position, showing that a system of control over the export and import trade is in operation, which if universally and effectively adopted is practically watertight. The illicit traffic however still continues to flourish, owing to a resort having been made to clandestine sources of supply or to parts of the world where control is less strict or non-existent. In dealing in conclusion with the medical and scientific aspects of the problem, Sir Malcolm briefly alluded to the treatment and after-care of the addict, the possibility of replacing the drugs wholly or partly by less dangerous substances, the rate of consumption of the drugs in different countries, and the question as to whether new drugs are habit-forming or not.

Engineering Research in Japan

IN vols. 10 and 11 of the *Japanese Journal of Engineering* recently issued by the National Research Council of Japan (Imperial Academy House, Veno Park, Tokyo), abstracts of varying length are given of some 400 papers on civil engineering, naval architecture, technology of ordnance, electrical engineering, mine engineering and metallurgy. The abstracts are printed in English, and about three-quarters of them relate to various aspects of electrical engineering. Some of the papers have been contributed to the Institution of Electrical Engineers of Japan, while others contain reports of researches carried out at the Electrotechnical Laboratory, Ministry of Communications, Tokyo, and at research institutions and universities. Corresponding journals issued by the National Research Council contain abstracts of papers on astronomy, chemistry, physics, botany, zoology and other branches of science.

Contour Maps of the East

AMONG the latest additions to Bartholomew's General World Series are maps of the Middle East (Persia, Iraq, Palestine, Syria, Turkey and North Arabia) and the Far East (China, Japan, Korea and Manchukuo) on scales respectively of 1:4,000,000 and 1:6,000,000. The maps are contoured and layer-coloured in green, brown and purple. Political and provincial boundaries are clearly marked, and on the map of the Middle East the chief roads, routes and caravan tracks are shown, as well as airports. All railways and the principal steamer routes are given. The scale allows a considerable amount of detail and a large number of names. The printing is clear, and the maps should prove most useful. The price of each map mounted on cloth and folded is six shillings.

The Cape Naturalist

IN November there appeared the first number of the *Cape Naturalist*, which is designed to increase the interest of non-technical readers in Nature and archaeology in South Africa. A striking cover reproduces the flower of *Stapelia*, the colour and carrion-like odour of which attracts blowflies which pollinate the flowers, and sometimes, deceived by the smell, deposit their eggs upon the petals. The articles are short and varied enough to make a general appeal (Pp. 24, price 7d. post free, from Mrs. Stephens, Alma Road, Rosebank, Cape Town.). The magazine is issued by the Cape Natural History Club, and should it meet a demand it will be issued quarterly, or possibly in time monthly.

International Hospital Congress

THE Fourth International Hospital Congress, which has been organised by the Italian Government, will be held at Rome on May 5-12, when the following subjects among others will be discussed: the hospital as part of a system of public health; the equipment and technical installation of hospitals; the work of the hospital and its protection in times of disaster. The Congress will be preceded by a tour of inspection of some of the large towns in northern Italy, and be followed by excursions in southern Italy, Sicily and Tripoli. Further information can be obtained from the International Hospital Association, Lucerne, Switzerland.

First Comet of 1935

A MESSAGE published in *The Times* of January 10 announces that a comet has been discovered by Mr. E. L. Johnson of the Union Observatory, Johannesburg. This comet will be called Johnson's comet, 1935A. The comet is presumably faint. Some half dozen faint comets are seen every year. For example, in 1933 there were six, ranging in magnitude at brightest from 8 to 18 (this was the faintest comet which has yet been observed). Of these, three were periodic and recognised as returns of known comets. It is some years since a notable, naked-eye comet appeared.

Scientific Meetings in Australia

MANY of the Australian scientific societies have arranged meetings for January in Melbourne, the natural centre during its centenary celebrations for conferences and congresses of all kinds. The Australian National Research Council held its annual session on January 15, when important questions of future policy were debated. It has been suggested that its scope be altered somewhat, and that it take the title of Royal Society of Australia, recently bestowed on a smaller scientific society established at Canberra. On January 16-23 the Australian and New Zealand Association for the Advancement of Science is holding its biennial meeting under the presidency of Sir Douglas Mawson. Public addresses are being delivered by Dr. P. Marshall on volcanoes of the Pacific and by Sir George Julius on certain aspects of the unemployment problem. Sir David Orme Masson is giving the Liversidge Memorial

Lecture to Section B on crucial advances in chemical theory during the last half century. Immediately following these sessions, the half-yearly meeting of the Council for Scientific and Industrial Research will take place: while many minor societies and groups of workers are arranging gatherings for discussion of matters of common interest.

Announcements

THE Council of the Physical Society has awarded the twelfth Duddell Medal to Dr. W. Ewart Williams, lecturer in physics at King's College, London.

WE regret to announce the death, on January 13, of the Rev. S. A. McDowall, chaplain and senior science master at Winchester College, aged fifty-two years.

THE Huxley Memorial Lecture of the Royal College of Science, South Kensington, for 1935 will be delivered on May 6 by Sir Henry Dale, director of the National Institute for Medical Research, who has chosen as his subject "Viruses and Heterogenesis: an old Problem in a new Form".

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. M. W. Gibbon, Mr. J. R. Miller and Mr. E. W. Momber, to be superintendents of agriculture, Nigeria; Mr. W. F. Baldock (assistant conservator of forests), to be senior assistant conservator of forests, Tanganyika; Mr. C. B. Bisset (assistant geologist, Nyasaland), to be field geologist, Uganda; Mr. A. de K. Frampton (agricultural superintendent, British Guiana), to be agricultural officer, Straits Settlements and Federated Malay States; Mr. G. L. R. Hancock (assistant entomologist, Agricultural Department), to be biologist, Makerere College, Uganda; Mr. E. F. Peck (veterinary officer, Nigeria), to be veterinary and agricultural officer, Somaliland; Mr. C. Smith (deputy conservator of Forests, Federated Malay States), to be conservator of forests, Johore; Mr. A. J. Wakefield (senior agricultural officer), to be deputy director of agriculture, Tanganyika.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An agricultural lecturer and warden at the Kent Farm Institute, Borden, Sittingbourne (Jan. 21). Teachers of science subjects and mathematics and engineering at the Willesden Technical College—The Secretary, Willesden Local Higher Education Committee, Education Office, Dyne Road, Kilburn, N.W.6 (Jan. 25). A head of the Junior Technical School for Boys, North-Western Polytechnic, Prince of Wales Road, Kentish Town, London, N.W.5—The Clerk to the Governors (Jan. 31). A veterinary pathologist in Malta—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Jan. 31). An assistant entomologist at the Rothamsted Experimental Station, Harpenden, Herts—The Secretary (Feb. 15). A professor of botany in the Egyptian University, Abbasia, Cairo—The Dean of the Faculty of Science (March 15).

Research Items

Queensland Aborigines. Further notes on the aborigines of Princess Charlotte Bay, North Queensland, have been published by Messrs. Herbert M. Hale and Norman B. Tindale (*Rec. S. Austral. Mus.*, vol. 5, No. 2). A study of the language and vocabularies of four tribes are included. Two types of canoe are in use, one in which a single outrigger is placed on the starboard side, and the other a double outrigger. The canoes are made from trees hollowed out, formerly by axes of stone, and the outriggers are supported by booms. In the first, the booms are lashed to crossed sticks which are attached to the outrigger; in the latter the booms are directly attached in pairs to each outrigger. The view held by Roth that the single outrigger is a local modification of the double is not accepted. It is thought that they are both due to external cultural influence, differing in time. The camps are both temporary and semi-permanent. The former may be constructed by small parties when away hunting. Their shelters differ considerably from those which are erected in the semi-permanent camps and may be occupied for weeks or even months. The temporary shelters are semicircular, and only four or five feet in diameter. They are formed of a framework of thin saplings, on which strips of bark are laid. Leafy boughs afford additional shelter from the sun. In the more enduring form, the huts are larger and higher. They are built in a rounded dome-shaped form with a circular base about ten feet in diameter. Bark completely covers the framework, except for the small doorway only twelve or sixteen inches in height. The bark is covered with thick tussocks of grass. This affords efficient shelter from all but the heaviest rains. The only shelters to which the term 'permanent' can properly be applied are caves and rock shelters. These are occupied by large bodies of natives for long periods, especially during the wet season. The surfaces of large rock shelters usually bear a number of paintings, many representing animals and other objects, which can readily be identified.

Ecology of a Bahaman Fresh-Water Lake. An interesting research by Mr. C. M. Breder, Jr., "Ecology of an Oceanic Fresh-water Lake, Andros Island, Bahamas, with special Reference to its Fishes" (*Zoologica*, 18, No. 3, 1934) is the result of short expeditions in January 1932 and 1933. This island represents a certain ecological condition that should be of particular interest to biologists. It is truly oceanic and of coral reef formation. The fishes in Lake Forsyth have already been listed (Breder 1932) and are the only vertebrate group which may be considered abundant. They are all typically marine, or at least brackish-water forms, and are apparently entirely supported by the dense beds of the peculiar brackish and hardwater plant *Batophora* flooring the bottom of the lake, or by the microscopic or nearly microscopic organisms living on its fronds; a certain number being predaceous and feeding on the former. The fish population in such fresh-waters as those on Andros Island may be accounted for by their ability to withstand fresh-water in which a sufficient amount of calcium is present. The few invertebrates present are mostly fresh-water forms, marine invertebrates in general not sharing the adaptability of the fishes and being much more susceptible to slight chemical

changes. "Lake Forsyth may be considered as representing a 'new' fresh-water environment in which invading forms are just commencing to establish themselves. Various gradations from this condition backward to purely marine conditions are represented in other Bahama Islands, Andros Island representing the most advanced position chiefly because of its greater drainage area."

Fish Gills Specialised for Oxygen Deficiency. Accessory respiratory organs in fishes are somewhat seldom, and then in a secondary sense, related to living out of water. In all fresh-water fishes with such accessory structures, the development of the structures has been correlated with existence in oxygen-deficient water, as Carter and Beadle notably showed for the inhabitants of the Gran Chaco swamps. Gerrit Bevelander has examined *Amia* from this point of view, and notes that the gills are in many respects different from those of other fishes. The lamellæ are highly modified into sieve plates, which are presumably highly efficient in absorbing oxygen under low tension, and possibly serve also in atmospheric respiration (*Copeia*, p. 121; 1934). He suggests that this specialisation is correlated with continued existence and activity in stagnant marsh waters, which would explain not only the habitat selection displayed by *Amia*, but also the survival of this 'living fossil' into present times.

Digestion of Wood by Insects. Since Lyonet in 1762 carried out the first crude experiments designed to discover how wood is digested by insects apparently feeding on it, a large number of investigators have attacked this fascinating problem. The history of these researches and the latest conclusions are very concisely surveyed in a recent paper by K. Mansour and J. J. Mansour-Bek (*Biological Reviews*, 9). The main conclusion is that the rôle in the digestion of wood of intracellular micro-organisms, often present in xylophagous insects, is not so important as was thought by many authors, particularly by Buchner and his school. Indeed, some wood-eating insects proved to be free of micro-organisms and yet able to survive on a wood diet, being able to secrete cellulose. The micro-organisms of others have been cultivated *in vitro*, and found to be unable to break down cellulose. In wood-eating termites, the intestinal Infusoria are utilised as a direct source of food, so that these insects should be classified as feeding on micro-organisms, not on wood. Many true wood-eaters do not depend upon cellulose and have no cellulase, but utilise starch and soluble sugars in the wood. Nitrogen is obtained probably from proteins which are practically always present in wood, while proteolytic enzymes have been found in most wood-eating insects. This makes superfluous the assumption that micro-organisms fix atmospheric nitrogen for the use of their host.

Wood Anatomy and Angiosperm Origin. Prof. G. R. Wieland has an interesting discussion from the palæobotanical point of view of recent contributions bearing upon this problem in "Tropical Woods" of 1934, the journal published by Prof. Record of Yale University. He deals especially with the new investigations of Hagerup, in which developmental

studies have been made of the conifer inflorescence by the method of serial sections. These researches have strengthened the view that the conifer phylum, including both *Pinus* and *Araucaria*, is a very homogeneous group. But Wieland dissents from the view that it is a necessary conclusion that the main source of the Angiosperms has to be found along a line from Conifers to Gnetales to Piperaceae and Juglandaceae. He recalls again the anatomical resemblances between the Cycads and the Cycadeoids which have been his own main interest, and the Angiosperms, especially those vessel-less members, the Homoxyleae of van Tieghem, which are again coming into the forefront of botanical interest. Gupta's recent review of the homoxylous woods is examined, but Wieland dissents from his tendency to put *Magnolia* and Cycadeoid into parallel rather than convergent lines. Wieland still evidently sympathises with Lemesle's conclusion (*Rev. gen. de Botanique*) that the Magnoliaceae are very ancient as compared with other Angiosperms (Lemesle regards the group as showing clear transition from scalariform tracheids to vessels) and that the 'Cycadeoid theory' of Angiosperm origin must still be reckoned with.

Cold Weather Planting in Northern India. In Forest Bulletin No. 86, "Cold Weather Planting in Northern India" (Delhi: Manager of Publications, 1934), Mr. H. G. Champion, sylviculturist at the Research Institute, Dehra Dun, deals with the planting problem in the United Provinces. Except where irrigation is an economic proposition, practically the whole of plantation work has to be done at the break of the rains, when the necessary labour is usually very difficult to procure and, even if obtained, is very liable to leave the work or be largely incapacitated by malaria and other complaints due to the general dampness, and to the unsatisfactory condition of the drinking water. After an allusion to the *taungya* methods of obtaining new crops, which are proving in some cases so great an assistance, Mr. Champion says that were it possible to do any appreciable part of the work in the cold or early hot weather, it would be most advantageous. Cold weather work would be of value because, for nearly all species, the most rapid growth occurs in the first week or two of the rains, or even before the monsoon has set in definitely enough for most planting work. This period is lost if the plants are only recovering from transplantation or the planting out work cannot all be completed in the very few early favourable days. This is an interesting comment since experiences in West Africa, under rather different conditions, are pointing in the same direction. The bulletin describes experiments made between 1927 and 1932 at Dehra Dun on planting out entire plants or stumps of thirty-three tree species after good winter rain, and a few trials of planting at regular intervals throughout the cold weather. As would be expected, the results varied greatly with the amounts of rainfall during the year of experiment, but very few species proved satisfactory. Teak stumps planted in March in the shade give good results provided the monsoon is not delayed, which has happened only twice in the period at Dehra Dun, but they may succeed in most years in more favourable localities.

The Alkali Metals. H. Alterthum and R. Rompe have prepared (*Phys. Z.*, Oct. 15, 1934) a long summary of work done on the alkali metals in the years 1930-33. The summary includes nuclear properties:

atomic weight, mechanical and magnetic nuclear moments, natural and artificial nuclear disintegration; electronic properties of the atoms and molecules, including spectroscopic data, fluorescence and gas-discharge work; chemical, electrical and optical data of the dispersed and of the massive metals. There is a special section on laboratory methods for the preparation of the pure metals. The lists of references given should be extremely useful to those working with these metals.

Non-Linear Mechanics. Three monographs on this subject, by Prof. N. Kryloff and Dr. N. Bogoliuboff, have been published at Kieff by the Academy of Sciences of the Ukraine, making a total of seventeen published there or elsewhere since 1931. Some are in French or German; those in Russian or Ukrainian usually have a French summary. The general problem is the solution of differential equations relating to motion which is approximately simple harmonic, but not exactly so. It is closely related to H. Bohr's theory of almost periodic functions, that is, of functions having no periods in the strict sense, but having an unlimited number of them to any given degree of approximation. However, the Russian authors are not, like Bohr and many others, concentrating on the purely mathematical and functional aspect, but are developing it from the point of view of differential equations and their physical interpretations. Among the wide range of their applications may be noticed astronomy (celestial mechanics), engineering (vibrations of synchronised machines), aviation (longitudinal stability of aeroplanes), and radio-telephony (properties of radio valves). They show that a phenomenon analogous to the Raman effect, which is usually regarded as explicable only by quantum mechanics, can be explained by classical mechanics as a simple consequence of the equations of motion not being exactly linear.

Characteristic Solution of a Differential Equation. It is well known that an integral equation can be found equivalent to the system made up of a linear differential equation and certain boundary conditions, and that the appropriate Green's function of two variables is closely connected with either system. A method of finding an integral equation corresponding to a differential equation without boundary conditions is now given by H. Nakano (*Japanese J. Math.*, 11; 1934). Again a function of two variables plays an important part. It is called the characteristic solution, but it must not be confused with the characteristic functions (of one variable) arising from a differential equation involving a parameter. The characteristic solution, unlike the complete primitive of the differential equation, contains no arbitrary constants; but if either is known the other can be easily obtained. Usually, of course, both are unknown, but we can obtain a certain amount of information about the characteristic function by means of an integral equation which can be set up in terms of the functions occurring as coefficients in the given differential equation. The author imposes severe restrictions upon these coefficients, and one wonders whether the methods could not have been extended so as to include an investigation of singularities. The later part of the paper applies the properties of characteristic solutions to a certain class of differential equations called *volleigentlich*, which may perhaps be translated as 'wholly proper'.

Geographical Studies and Teaching

GEOGRAPHICAL ASSOCIATION

THE annual meeting of the Geographical Association was held at the London School of Economics on January 2-5. Lord Meston in his presidential address dealt with the "Geography of an Indian Village", referring particularly to his own experience as a settlement officer in the United Provinces in the early days of his service in the Indian Civil Service.

This careful description of the work of a settlement officer has a great importance as illustrating the use of a thorough local geographical study as a basis for property valuation, taxation and local administration. When the assessment or reassessment of a District (using that term in its Indian sense as meaning an administrative unit, commonly 1,000-3,000 square miles in area) becomes necessary, the work, which is likely to occupy three or four years, is entrusted to a 'settlement officer'. He starts by securing a general view of the whole area, and in the careful descriptions prepared there exists, hidden away in Government offices throughout India, a vast store of unpublished material of great geographical value. He then undertakes systematically the survey of each village—a 'village' designating the tract of land (in the United Provinces commonly 50-1,000 acres) round the hamlet or residential centre. A base map—usually on the scale of 16 inches to one mile—is prepared either by the Survey of India or by an *ad hoc* survey party controlled by the settlement officer. Each field is numbered and a description of it made by the village accountant. The record includes the character of the soil, crops, ownership, occupation, taxable value and taxes paid. The soil classification commonly used is into black cotton soil, first-class loam, second-class loam, sandy loam, sand, gravel and uncultivable. It is not perhaps fully realised that there exists for practically the whole of settled India this accurate soil and land utilisation survey.

The nucleus of the older type of Indian village in the United Provinces is usually the ancestral home of the chief landowner surrounded by its mud wall. Around it is an irregular ring of houses—arranged with very little planning and no sanitation; then the hovels of the depressed classes. The village pond, which serves as a public bath for man and beast as well as for a supply of drinking water, completes the picture. Surrounding the hamlet is a ring of richly manured land but which, because of the source of its manure, is only cultivated by the depressed classes, and then finally the arable land of the villagers. Reference was made by Lord Meston to changes in soil and soil values which are tending to result from the extension of irrigation—including the impoverishment consequent upon the accumulation of alkali.

Two sessions of the Association were held in conjunction with the Le Play Society. At one, Mr. A. E. Moodie gave an account of studies carried out in the Stubaital in the Austrian Tyrol. At the other, under the chairmanship of Sir John Russell, the leader of the party in the field, three short papers were presented on Russia. Mr. R. A. Pelham gave a historical introduction, Dr. A. S. J. Baster, an economist's view, while Mr. Leonard Brooks gave a fascinating account of recent educational developments. He emphasised the central place that the

factory occupies in the life of a community and that, like other activities, the school is attached to it. As vocational education, the system is good in the essentially close contact which is maintained. The children are given a conspectus of the whole working of the factory, and can afterwards take their places in different parts of the works. Similarly, the university has almost entirely given place to specialised technical research or training institutions. There are already signs, it would appear, of the desire to return to a more general educational system, at least in places, but the general progress in literacy made in the last five years is so amazing as to be almost incredible.

Dr. G. P. Gooch in his address on "Geography and International Problems" indicated clearly the importance attached by historians to the geographical background, but at the same time illustrated the need for closer co-operation between specialists. His sketch of the geographical background of China could not possibly be accepted by geographers, nor could his description of the Saar.

Dr. Dudley Stamp in his lecture on "Planning the Land for the Future" referred particularly to recent studies in land utilisation in the United States. At present, out of a total area of 3,000,000 square miles, the proper use of roughly a third is not yet decided. For the best types of land in the country—for example, the belts of good soil in the Middle West—it is clear that they must remain in agriculture. Similarly, for the poorest lands the proper use is clearly desert, forest or grazing. The problems arise in areas of intermediate value. Amongst the reasons for existing mal-utilisation of land some of the chief are: (a) those consequent upon the history of settlement—the clearing of poor land in the East before the better land was discovered; (b) the ravages of soil erosion; (c) the development of communications throwing all areas into ready contact and rendering cultivation in poorer tracts uneconomic; (d) 'over-production' of agricultural commodities consequent upon technical progress combined with diminution of foreign trade; (e) the depletion of forest lands; and (f) social changes—the need for more land for recreation or for semi-subsistence cultivation. A summary was given of work undertaken, especially under the Roosevelt administration, to combat the difficulties. Of the varied planning schemes, those based on the economic needs of the moment are fraught with danger; those based on a careful investigation of the potential capacities of the land are working on a sure foundation.

Among the interesting lectures of a general nature must be mentioned that by Brigadier H. St. J. L. Winterbotham on the history of the Ordnance Survey, Dr. Bernard Smith on water supply and Dr. Allen Mawer on place name study.

INSTITUTE OF BRITISH GEOGRAPHERS

The formation of the Institute of British Geographers was recorded in NATURE of January 14, 1933, and the Institute held its third annual meeting at the London School of Economics on January 1 and 4 of this year.

Dr. H. A. Matthews dealt with the "Seasonal Distribution of Rainfall in the Mediterranean Region of California" by a careful analysis of dispersion

diagrams. The results, in this area, confirm the general simplicity of the regime and do not therefore add greatly to the information obtained by using mean monthly rainfall values, but a clear demonstration is afforded of the value of a logarithmic scale in plotting seasonal variation. Variability of monthly precipitation increases markedly (a) from north to south and (b) from lower to higher elevations.

Mr. E. G. Bowen showed the results of attempting to map the 'spheres of influence' of the missionary saints of the Dark Ages, choosing St. Samson and St. Columba, in Celtic Britain. These spheres seem to coincide with cultural provinces determined on the basis of archaeological distributions, but in the discussion various reasons were suggested for this. Mr. K. H. Huggins's paper on "Types of Settlement in the Scottish Highlands" was concerned to a considerable degree with the delimitation of the 'Highlands' as distinct from the 'Lowlands'. By using such criteria as structure, elevation, 'amount of relief', proportion of moorland, type and density of settlement, different 'limits' to the Highlands are obtained, and there is clearly a central area where all the Highland characteristics are present, fringed by a broad transitional area.

Mr. K. C. Edwards dealt with the consequences of recent improvements in the River Trent as a waterway—including the growth of Nottingham as a leading distribution centre for petroleum products.

The distribution of settlements, permanent and temporary, and of cultivated crops in Alpine valleys, is a subject of considerable importance and concerning which there is an extensive literature. But an important advance in knowledge is marked by Miss Alice Garnett's careful and suggestive study of insolation. A formula for the calculation of insolation intensity at any given spot (based on slope, aspect and the sun's elevation) has been devised and it is possible to construct 'intensity maps'. Special importance is attached to spring noonday intensity values. At the same time 'time periods of insolation' are mapped and the results are combined.

This method of investigation seems to demonstrate a possible law of alpine settlements, namely, that above *c.* 1,100 m., all permanent settlements avoid the areas of winter shade, while *ubac* villages follow the *edge* of the winter noonday shadow line. For regions studied in lat. 46° N., above 1,400 m., wheat, barley and rye require at least an 80–90 per cent spring noonday intensity. Wheat can ripen up to *c.* 1,600 m. where a noonday equinox intensity exceeds 90–95 per cent of the maximum possible at that time, provided these areas also have long time periods of insolation. Areas with a 50–70 per cent intensity are generally given over to meadow, while land with an intensity value of less than 50 per cent is left to forest. It is abundantly clear that this study has an important bearing on land planning in alpine areas and is capable of extension to regions of lower relief in higher latitudes—for example, to the Highland valleys of Scotland and Antrim, where the intensity and time period of insolation would seem to have a bearing on health problems.

Dr. S. W. Wooldridge, by a preliminary analysis of areas in the London basin, dealt with the 'facet' as the ultimate unit of geographical analysis. The facet is difficult of definition though the concept is clear. A river terrace, a dip slope, a plateau (even if only a fragment) are 'facets' which thus correspond in general with geomorphological units, but in detail have different boundaries. Thus the 'Taplow Terrace facet' as a geographical unit does not coincide with the distribution of the Taplow Terrace gravels of the geological map.

The last session of the meeting was devoted to a discussion of Prof. C. B. Fawcett's paper on the relations between the advance of science in geography and the life of the community, read before the British Association at Aberdeen in September last.

The Institute, in accordance with its avowed policy of publishing memoirs too long for inclusion in existing periodicals but unsuitable for publication in book form, has issued, as its first volume, Dr. R. O. Buchanan's study of the pastoral industries of New Zealand. L. DUDLEY STAMP.

Annual Meeting of the Mathematical Association

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W.C.1, on January 7–8, under the presidency of Prof. E. H. Neville, of the University of Reading. The following distinguished mathematicians were elected honorary members of the Association: Profs. E. Borel (Paris), J. Hadamard (Paris), G. H. Hardy (Cambridge), D. E. Smith (New York), E. T. Whittaker (Edinburgh). Mr. A. W. Siddons, of Harrow School, was elected president of the Association for the forthcoming year.

In his presidential address, entitled "The Food of the Gods", Prof. Neville dealt with a problem in mathematical education which is of considerable importance and difficulty. From the fact that the preparation given to a schoolboy a quarter of a century ago for an entrance scholarship examination at Cambridge would be adequate to this examination as it is at present, while the undergraduate of those days would find many of the questions in a modern tripos incomprehensible, he deduced that the universities of to-day build a different mathematical structure, but are content to build it on foundations which have not changed since the beginning of the

century. Since this difference is due to the direct influence of changes in emphasis in creative mathematics on the teaching at the universities, he urged that such changes ought to have a greater and far more rapid influence on teaching at the schools than they seem to have. Room for new ideas can only be found by omissions or condensations, by the expulsion from the curriculum of methods and ideas once valuable but now outworn, kept in place through inertia. To demonstrate the possibility of such a reform, Prof. Neville gave some examples illustrating the successful working of a similar process at the undergraduate stage. To bring this about at the school stage, the young teacher has the knowledge of what is important, the old teacher has the experience of what is practicable and the influence to effect the changes he desires, and Prof. Neville sees in this an opportunity for the generations to co-operate. At present, each advance is followed by a score of years in which the backward schools and the popular textbooks creep up to the leaders; he envisages a responsiveness everywhere to the ferment of current ideas, which should result in a mathematical nourishment requiring no long periods of accommodation, the true 'food of the gods'.

Following the presidential address, Brigadier H. St. J. L. Winterbotham, Director-General of Ordnance Survey, spoke on "Geography and Mathematics", detailing the many and various ways in which a knowledge of mathematics assists geographical progress.

Of the four papers which occupied the morning of January 8, that which attracted most attention was given by Mr. G. L. Parsons, of Merchant Taylors' School, under the title "The Work of a Junior Mathematical Association". The members of this Association are some eight public schools in the London area; five meetings are held each year, and a good attendance of the mathematically-minded pupils in the higher forms of these schools is obtained. Occasionally the meetings are addressed by distinguished adult mathematicians, but more frequently by the boys themselves, who are thus encouraged in habits of independent thought and research. Sir James Jeans is the president of the Association, and the president's annual essay prize attracts many excellent entries.

In the afternoon, Prof. D. R. Hartree, of the University of Manchester, gave a paper on "The Bearing of Statistical and Quantum Mechanics on School Work"; after asserting that the new mechanics has no direct bearing on school work, he explained in elementary terms some of the basic concepts of the subject in such a way as to illustrate the indirect influence the new ideas might be expected to exert on school work in mathematical physics. Following this, the warm interest which members of the Association invariably take in points of teaching practice was again demonstrated by a lively discussion on "The First Encounter with a Limit", in which teachers from the schools and universities took part. The meeting ended with a delightful lecture by Prof. G. H. Hardy on "The Theorem of the Arithmetic and Geometric Means", in the course of which he discussed several different proofs of the fundamental inequality connecting these two means, and incidentally directed attention to some very important, but much neglected, work by Dr. R. F. Muirhead on inequalities of a more general type.

Work of the Rothamsted Experimental Station

AS knowledge of plant growth accumulates, the number of points from which the problem of crop production can be attacked increases. Since the foundation of the Rothamsted Experimental Station in 1843, the activities of the Station have been steadily extended so as to make it possible to follow up some of the new problems which are continually brought to light by the work there and elsewhere. The study of quality in crops, for example, has led to a considerable amount of work in conjunction with the Institute of Brewing, the Millers' Research Association, sugar beet factories, etc. The work on malting barley, for example, has outgrown the accommodation at Rothamsted, and, having reached the stage where closer contact with the brewing industry was necessary, has been transferred elsewhere.

The Rothamsted report for 1933* gives a brief summary of the various problems under investigation during the year at Rothamsted and Woburn, and also includes trials carried out at outside centres. Though the field and laboratory work are really one, they are, for the sake of convenience, dealt with separately in the report. The report includes results of some schemes of experiments conducted on a uniform basis at a number of centres; for example, results of ten years experiments with malting barley, and of experiments on the effect of fertilisers on the yield and quality of sugar beet. A list of papers published from the Station is also included, together with comments on the contents of each.

The problem of soil organic matter continues to receive attention, the plan of investigation being one designed and begun some years ago. This problem is important in view of the possibilities of mechanised cereal growing, and the Rothamsted experiment will help in answering the question which will inevitably be asked by those contemplating farming under the new conditions—how far it is possible to practise mechanised corn-growing and pay no attention to replenishing the stocks of soil organic matter by the addition of farmyard manure, sheep folding, etc.

That the solution of this problem is not so simple as was once considered is gathered from the observation in the report that green manures do not keep up the productiveness for wheat of the light soil at Woburn, and that the residual values of farmyard manure and of cake and corn fed to animals at Woburn appeared to be much less than is indicated by the recognised tables. The latter observation has also an important bearing on the existing method of assessing certain compensations due on the termination of tenancies.

Dr. R. A. Fisher, who left in October 1933 to take up his new duties as Galton professor in the University of London, has written a short account of the contribution of Rothamsted to the development of the science of statistics. One development, namely, the realisation that it was necessary to treat the question of field procedure and that of statistical analysis as but two aspects of a single problem, has resulted in definitely increasing the value of experimental work. To quote Dr. Fisher, "By applying statistical methods not only to the interpretation but also to the design of experiments, it is not uncommon for the value of the experiment to be increased five or ten fold, a result which could not be obtained from improved methods of interpretation only". It is doubtful, for example, if the capacity of superphosphate and sulphate of ammonia for reinforcing each other's effect could have been detected and estimated if it were not for the improvements in plot technique and interpretation of results. The Statistical Laboratory has tackled the problem of technique in live-stock trials, having commenced by a successful pig feeding experiment; the pens and feeding arrangements have been designed so that all types of rations are distributed equally over all the groups of pens instead of all the pigs on one treatment being in the same pen.

The report is essential for those engaged in teaching or research work. The long-term experiments and the thoroughness of the liaison between field and laboratory work give added value to the work at Rothamsted. The practical farmer will also find the report interesting, but most of the results will doubtless reach him through the medium of the agricultural Press.

* Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1933. Pp. 200. (Harpenden: Rothamsted Experimental Station, 1934.) 2s. 6d.

University and Educational Intelligence

LIVERPOOL.—Prof. H. H. Read, George Herdman professor of geology, who has just been awarded the Bigsby Medal of the Geological Society of London, has worked largely on the geology of the Highlands. He has made a number of important discoveries on the complicated region of lower Banffshire and north Aberdeenshire, and has just published a paper on the geology of Unst, in the Shetland Islands.

EDUCATIONAL problems in India are, perhaps, more various and more baffling than in any other country, and among the most difficult are those of the education of the Anglo-Indian child. Also, at the present time, they are of peculiar urgency owing to the progressive limitation in recent years (and the prospect of still more drastic limitation in the near future) of the fields of employment open to the Anglo-Indian community and the simultaneous increase (from 1921 until 1931, 22 per cent) in their numbers: some 20,000 who ought to be earning their living are actually unemployed. A valuable and timely discussion of the subject is reported in the *Journal of the Royal Society of Arts*. A paper read on November 9 before the Indian Section of the Society by the Very Rev. J. A. Graham, honorary superintendent of St Andrew's Colonial Homes, Kalimpong, Bengal, describes what has proved to be an efficient enterprise for enabling needy Anglo-Indian children to develop into worthy members of society. Beginning in 1900 with six children, it has grown into an educational colony in which 575 boys and girls housed in cottages are being trained for such occupations as agriculture, engineering, the railway, telegraph and forest services, business, teaching and nursing. In the course of the discussion which followed the reading of the paper, attention was directed to the recent inauguration of a ten thousand acre colony at Lapra in Bihar. This was described as one of the most hopeful of projects hitherto tried for providing openings for Anglo-Indians.

Science News a Century Ago

Translation of Cuvier's "Animal Kingdom"

Cuvier's "Animal Kingdom", which had been published in fifteen volumes by Edward Griffith and others, was reviewed at length in *The Times* of January 24, 1835. The whole of the Baron's "Règne Animal", said the reviewer, has been translated with a vast addition of supplementary matter, including a full description of all the species, calculated to render the work "not merely useful to the naturalist, as a book of pure science, but also interesting to the public at large, as a general zoological biography, and ornamental as containing original and well executed illustrations. . . . The gentlemen who have been associated with Mr. Griffith in this arduous undertaking are Mr. Edward Pidgeon, Colonel Charles Hamilton Smith, Mr. John Edward Gray and Mr. George Gray. Their competency and qualifications are sufficiently well known. . . . Without entering into a more elaborate examination of the work, we may confidently characterise it as one which cannot fail to recommend itself to a very high rank in public estimation. It appears to have been executed with great care; it evinces a large share of scientific talent and research in the editors; and the plates, some of

them from drawings by Landseer, are distinguished by great neatness and fidelity."

Of the authors of this work, Griffith (1790-1858) was an original member of the Zoological Society, John Edward Gray (1800-75) was a keeper at the British Museum and Col. Smith (1776-1859) served in the Army in 1797-1820. After the appearance of the review, a correspondent wrote to *The Times* saying that Edward Pidgeon had died in poverty on October 14, 1834.

Beaufoy's "Nautical and Hydraulic Experiments"

Col. Mark Beaufoy (1764-1827), the son of a Quaker brewer, was a physicist and astronomer, but he will be remembered longest for his experiments on ship resistance, and as the founder in 1791 of the Society for the Improvement of Naval Architecture. His experiments were made in Greenland Dock, Rotherhithe, during the period 1793-98. After his death, his son published at his own expense his "Nautical and Hydraulic Experiments with numerous Scientific Miscellanies", the book being printed at Beaufoy's private press in Lambeth. In a review of the first volume of this work published in the *Athenæum* of January 24, 1835, many passages were quoted. One of these said: "For some years the calculations were made at Colonel Beaufoy's residence at Hackney Wick by himself, assisted by his wife, who contributed no inconsiderable share to the progress and success of the experiments; for favoured alike in person and in mind . . . she was a good mathematician and astronomer familiar with all the details of the observatory, the calculation of eclipses etc. . . . she was never at a loss for leisure in the furtherance of her husband's pursuits."

In concluding his remarks, the reviewer said, "we have only to express our obligations to the publisher for the munificent gift he has laid on the altar of science. By the time his work is completed, it will, it is reported, have cost together with the experiments it records, a sum of 60,000£, the value of thirty years assiduous labour not being counted in this estimate. There is a munificence and devotion about this gift, which have, we believe, no parallel in the history of science".

Records of General Science

In January 1835, the first number appeared of a *Record of General Science*, a monthly journal edited by Dr. R. D. Thomson, lecturer in chemistry in the Blenheim Street Medical School, with the assistance of Prof. Thomas Thomson, regius professor of chemistry in the University of Glasgow. It was published by John Taylor, 30 Upper Gower Street, London, bookseller and publisher to the University of London. In the preface, after some remarks on the general history of periodicals, it was said: "A few years have only elapsed since not less than six Scientific Journals were published in Great Britain; these have now dwindled into two one of which is published monthly in London, and the other quarterly in Edinburgh". The number opened with an article by Prof. Thomas Thomson "On Calico-Printing", illustrated with actual samples of material pasted in. Other articles dealt with respiration, the composition of the blood, vanadate of lead, transmission of heat through bodies, distillation of pit-coal and the magnetic intensity of the earth. Some of the articles were original contributions, while others were reprinted from the leading scientific journals published on the Continent.

Societies and Academies

PARIS

Academy of Sciences, December 10 (*C.R.*, 199, 1345-1463).* WALTER M. ELSASSER: Forces and nuclear linkages. JOSEPH LAISSUS: The cementation of ferrous alloys by beryllium. Cementation by beryllium increases the superficial hardness of ferrous alloys, reduces the oxidation at high temperatures and increases the resistance to corrosion. JEAN COURNOT and MARCEL CHAUSSAIN: Study of the influence of the mode of immersion of the test-pieces in corrosion experiments. JACQUES LEFOL: The hydrates of calcium aluminates, sulphoaluminate and chloroaluminate. SHINICHI KIKUCHI: Lithium cobaltinitrite. The preparation and properties of lithium cobaltinitrite, $\text{Li}_3\text{Co}(\text{NO}_2)_6 \cdot 8\text{H}_2\text{O}$. PIERRE DUBOIS: The hydrate and allotropic varieties of manganese sesquioxide. C. ZENGHÉLIS and SIMON EVANGELIDÈS: The action of the silent discharge on nitric oxide (NO). The first phase of the reaction gives nitrogen (partly in the active form) and oxygen with some ozone. Subsequent recombination gives nitrogen peroxide and nitrogen pentoxide. SÉBASTIEN SABETAY: A rapid method for the determination of primary and secondary alcohols in essential oils. The method is based on acetylation with acetic anhydride using orthophosphoric acid as catalyst. PIERRE CARRÉ and DAVID LIBERMANN: The preparation of acid chlorides by means of thionyl chloride. Pyridine facilitates the reaction between thionyl chloride and certain organic acids and allows the preparation of some acid chlorides not formed in the absence of pyridine. FERNAND KAYSER: The two 1, 2-diphenyl-1-propanols and the two 1, 2-diphenyl-1-butanols, diastereoisomers. G. DARZENS and ANDRÉ LÉVY: The synthesis of a tertiarybutyl-methyltetrahydronaphthalenic acid and of the corresponding butyl-methylnaphthalene. JOSEPH HOCH: The preparation of the N-substituted imines of the fatty ketones. ARNALDO PERES DE CARVALHO: A γ -pyran of simple function, 2, 4, 4, 6-tetraphenylpyran. MARCEL FRÈREJACQUE: The mechanism of the autoxidation of uric acid. ANDRÉ DEMAY: The southern edge of the granite-gneiss massif of Ségala. ROBERT LAFITTE: The stratigraphical limits of the Senonian in eastern Aurès (Algeria). G. GRENET and J. COULOMB: New forms of electromagnetic seismographs. V. FROLOW: The propagation of the elementary components in the Yugoslav basin of the Danube. PIERRE DANGEARD: The structure and evolution of the nuclei with chromocentres. HENRI ERHART: The influence of the pedological origin of seeds in the culture of cereals. RENÉ MORICARD: Study of the modifications of the Golgi zone of the perioocytary cells in their relations with the development of the oocyte and of the release of the precessive maturation mitosis of ovulation and of the formation of the yellow body in the rabbit. A. PAILLOT: Cytological and organic modifications brought about in aphids by parasitic Hymenoptera. MAURICE FONTAINE: The relation between the ossification of the skeleton and of the state of the blood calcium in fish. PH. LASSEUR and M. A. RENAUX: The agglutination of various bacteria by lemon juice. The facts cited suggest that the agglutination is caused by the hydrogen ions rather than by an antibody. GASTON RAMON, RÉMY RICHOU and MILOUTINE DJOURICHITCH: 'General' and 'local' antitoxic immunity. Experiments showing that the idea of a

strictly local immunity is untenable. JEAN SABRAZÈS and JEAN JACQUES BOUNHIOL: Experimental researches on post-traumatic nephritis in the rabbit. Mlle. ANDRÉE MICHAUX: The amounts of chlorine and total phosphorus in the brain of guinea pigs, either normal, starved, attacked with chronic or acute scurvy. The amounts of magnesium in the striated muscles.

BRUSSELS

Royal Academy (*Bull. Classe. Sci.*, No. 10). CL. SERVAIS: On the geometry of the tetrahedron (11). LUCIEN GODEAUX: (1) On Zeuthen-Segre's invariant of an algebraic surface. The author points out that a theorem concerning Zeuthen-Segre's invariant recently published by Campedelli was discovered by Godeaux in 1914 and published in 1920 in the journal of a local scientific society. (2) Remarks on the rational correspondences between two surfaces of genus one. P. STROOBANT: Contribution to the study of the local system: galactic distribution of helium stars. The great majority of helium stars (type B stars) form a flattened agglomeration in confirmation of Charlier's views. The median surface of the system is not quite plane: its intersection with the plane of the galaxy is situated at 49° and 254° , while the maximum inclination is found at 175° and 320° of galactic longitude. E. HENRIOT: Angular momenta in electromagnetic theory (2). The electromagnetic theory of a refractive medium is considered and the angular momentum of a rotating electrified sphere is calculated. POL BURNIAT: On the birational transformations of space having two isolated associated fundamental points (2). The transformations T_1 and T_2 . O. ROZET: On the congruences of straight lines belonging to a linear complex. A. DE WAELE: Researches on the migrations of Cestodes (4). A study of *Coenurus cerebralis* in the living state and a comparison of its behaviour with that of *Cysticercus pisiformis*. MARCEL FLORKIN: On the activity due to anhydrase of the interior medium of invertebrates. An examination of the blood, etc., of numerous invertebrates for the presence of the ferment, carbonic anhydrase, frequently with negative results. Z. M. BACQ and HENRI FREDERICQ: An attempt to identify the chemical transmitter liberated in the nictitating membrane of the cat by sympathetic stimulus. The experiments show that natural *l*-adrenalin is the only substance which is able to reproduce with fidelity the phenomena shown by the chemical transmitter.

GENEVA

Society of Physics and Natural History, October 18. CH. EUG. GUYE: The propagation of imbibition. F. BATELLI, DON ZIMMET and P. GAZEL: The existence in muscle of a state opposing the stimulating action of a continuous current. There appears to exist in the muscle of the frog a state which is opposed to the action of the continuous current during its passage. This condition may be represented by a voltage of from one to three volts. If the muscle is submitted to a much higher voltage, its own potential is dominated by the potential imposed on it and it remains half contracted. The myogram shows a plateau.

November 1. M. GYSIN: The presence of dipyrre in the metamorphic formations of the Kundelungu of Haute-Lufira (Belgian Congo). The Haute-Lufira basin is constituted essentially by the lower Kundelungu arranged in folds parallel to the direction west-north-west. The anticlinals are marked out by faults and by zones of breccia with numerous

*Continued from p. 79.

outcrops of diabases. The sediments of the Kundelungu are strongly metamorphosed and contain diopside crystals. This metamorphism appears to be due to the perimagmatic action of the diabases. H. SAINT: Note on the thermodynamics of the phenomena of imbibition and of amalgamation. The problem of the propagation of a liquid by imbibition in a porous body, or by spreading out on a surface (mercury on gold) may be treated from a thermodynamical point of view by considering the free energy by the Helmholtz equation. If the phenomenon is endothermic (amalgamation of gold), it is found that the external work E against gravity and frictional forces should increase when the temperature T is raised. If the phenomenon is exothermic, E may either increase or diminish when T is increased. A. MERCIER: The relations between the distribution of the densities of the earth's crust and the values of gravity. Likening the continents to blocks of sial immersed in the sima and applying to them the laws of hydrostatic equilibrium, the anomalies observed in measurements of the intensity of gravity are approximately accounted for. The calculation is made for the region of the Alps and gives a value for the anomalies within the limit of the experimental results. F. BATELLI, D. ZIMMET and P. GAZEL: The hæmolysing action of tobacco smoke and of the smoke from other plants on the blood *in vitro*. R. WAVRE: The representation of certain uniform functions. W. SCHOPFER: Action of growth factors contained in urine. The action on a micro-organism. The author shows that normal human urine contains a substance, differing from the usual substances and acting as a growth factor for a micro-organism. This substance is soluble in ethyl alcohol, dilute acetone, methyl alcohol and chloroform but insoluble in ether and benzene. It is thermostable and is adsorbed by animal charcoal. It differs from auxine and may arise from plant food.

LENINGRAD

Academy of Sciences (C.R., 3, No. 8-9). N. KOSHLIAKOV: Some summation formulae connected with the theory of numbers (2). P. NOVIKOV: Some aggregate systems invariant in relation to the A -operation. R. KUZMIN: Theory of the $L(s)$ series of Dirichlet. G. GUREVITCH: Trivectors in a space of seven dimensions. P. RASHEVSKIY: Infinitesimal properties of geodesic lines in a two-dimensional space, in connexion with the measurement of an area. I. KURCHATOV, G. SHCHEPKIN and A. WIEBE: High-speed electrons liberated from fluorine after bombardment by neutrons. V. CHERDYNCEV: Systematics of atomic nuclei. N. VEDENEVA and S. CRUM-GRZHMAILLO: Spectro-polariscope method of Umov as applied to the examination of minerals under the microscope. B. SHPAKOVSKIY: Dispersion of ultra-sonic waves in a liquid. V. ALPATOV and O. NASTJUKOVA: Susceptibility of *Paramecium caudatum* to ultra-violet rays in relation to the colloidal properties of their protoplasm as it is affected by different physico-chemical methods. Resistance of protoplasm to the destructive action of ultra-violet radiation can be increased by using electrolytes causing condensation of colloid, and reduced by using electrolytes which cause swelling. V. KURIAVCEV: A new apparatus for the determination of the vapour pressure of solutions by the dew-point method. I. KROTOV: Methods of obtaining and investigating stannic and stannous sulphocyanides. I. NAZAROV: Splitting of di-tertiary alkylcarbinols by dehydration. The dehydration of

tertiary butyl-tertiary amyl- and tertiary butyl-tertiary hexylcarbinols. A. BRODSKIY, V. ALEXANDROVICH, M. SLUCKAJA and M. SHELUKCO: Concentration of heavy water. Some improvements in the method suggested by Lewis and Macdonald (*J. Chem. Phys.*, 1, 341; 1933) are described. A. LOZOVJOY and M. DJAKOVA: Chemical composition, properties and methods of treatment of the primary tars of the Tcheliabinsk lignites. A. PARSHIN (1): Fermentative splitting of adenylypyrophosphate in heart muscle. (2) Metabolism of adenylypyrophosphate in isolated frog's heart. A. STUDITSKIY: Mechanism of the formation of regulating structures in the embryonic skeleton. Work executed on chicken embryos suggests that an organism in the embryonic state possesses mechanisms that are capable of complicated autonomous regulatory processes. J. KERKIS: Development of the sexual glands in interacial hybrids of *Drosophila pseudo-obscura*. A. ZAVARICKIJ: Pseudoleucitic and epileucitic rocks. D. BELJANKIN: Albite with small angular separation of optical axes from the Druzhnaya Gorka works. N. ANNENKOVA: Paraonida of the Far Eastern seas of Russia. Descriptions of three new species of worms of this family. A. SVETOVIDOV: Growth of the Baikal whitefishes and graylings. The rate of growth in Lake Baikal is considerably greater than elsewhere. S. CHERNOV: Subspecies and the distribution of the lizard *Eremias arguta*, Pall. I. OLENEV: Pasture ticks (*Ixodoidea*) in the north-west of Russia. A. TARANEC: Species of the genus *Hypomesus* in the basin of the Sea of Japan.

PRAGUE

Czech Academy of Sciences and Arts, December 14. E. VOTOČEK: A detailed study of the fucohexonic and rhodeohexonic acids and the configuration of their α -carbon. E. VOTOČEK and F. VALENTIN: Mercaptan condensation with 5-ketomethylpentonic acids. New sulphur derivatives obtained by condensation of 5-ketomethylpentonic acids with different alkyl mercaptans. This reaction represents a new transition from sugars to the furan series. K. CEJPK: New finds of Saprolegniales in Bohemia. V. HOVORKA: Separation of selenium from cadmium, lead, bismuth, antimony, molybdenum, tungsten and vanadium. V. HOVORKA: The loss of selenium in the reduction of selenites by hydrazine. F. KRATOCHVÍL: Beryl from Mechov near Poběžovice. F. PRANTL: Carboniferous Bryozoa of Dobšina. V. ZÁZVORKA and J. SOUKUP: Cretaceous fossils of the Bělohrad country. V. POSPÍŠIL: Measurements of the influence of light on Brownian particles (dark ground illumination). V. POSPÍŠIL: Mechanical theory of white day-seeing and night-seeing. R. RŮŽIČKA: Barrandien trilobites. B. BOUČEK: Trilobites from the Czech Gotland (2). J. SLÁDEK and M. LIPSCHÜTZ: Polarographic effects of some amino-acids. This sensitive test for the sulphhydryl group of peptides is obstructed by arginine, tryptophane, histidine, β -phenyl- α -alanine, and β -phenyl- β -alanine, contained in remedies for pernicious anaemia. The β -phenyl- β -alanine, containing a labile hydrogen, gives a sensitive catalytic effect. J. H. KŘEPELKA and J. KUBIS: Study of ter- and quadrivalent manganese. At -70° a purple solution of manganese trichloride in ether was prepared, which formed a black precipitate with benzene or carbon tetrachloride. Solid manganese tetrachloride cannot be prepared under these conditions. K. URBAN: The basic magma of the south slopes of Dumbier in the Low Tatras.

Forthcoming Events

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

Sunday, January 20

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—
M. A. Phillips: "Fossil Reptiles".*

Monday, January 21

KING'S COLLEGE, LONDON, at 5.30.—Prof. G. Temple:
"The Theory of the Radiation and Reception of Electro-
Magnetic Waves by Aerials (succeeding lectures on
January 28, February 4, 11, 18, 25, March 4 and 11).*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Martin Lind-
say: "The British Trans-Greenland Expedition of
1934".

Tuesday, January 22

BRITISH INSTITUTE OF PHILOSOPHY, at 8.15.—(at Uni-
versity College, London, W.C.1).—Sir Herbert Samuel:
"Philosophy, Religion and Present World Conditions".*
(Ticket.)

Wednesday, January 23

GEOPHYSICAL DISCUSSION, at 5.30.—(Joint meeting with
the Geological Society in the rooms of the Geological
Society, Burlington House, W.1). "The Hypothesis of
Continental Drift", to be opened by Dr. W. B. Wright.

ROYAL SOCIETY OF ARTS, at 8.—C. L. Burdick:
"Humidity, Health and some New Inventions".

Thursday, January 24

QUEEN MARY COLLEGE, at 5.—Prof. W. N. Haworth:
"The Molecular Structure of Carbohydrates".*

Friday, January 25

KING'S COLLEGE, LONDON, at 3.15.—C. J. Jadd:
"Babylonian Ideas of the Relations between Gods and
Men".*

ROYAL SOCIETY OF ARTS, at 4.30.—C. Ranganatha Rao
Sahib: "Recent Industrial Progress of Mysore".

ROYAL INSTITUTION, at 9.—Sir Richard Livingstone:
"Ancient Greece and Modern Civilization".

Official Publications Received

GREAT BRITAIN AND IRELAND

British Industries Fair, 1935, Olympia and White City, London,
February 18th to March 1st. Organized by the Department of Over-
seas Trade. Special Overseas advance edition. Pp. xvi+496+Ad.
168+Ad. xii. (London: Department of Overseas Trade.) 1s.

Catalogue of the Twenty-fifth Annual Exhibition of Scientific
Instruments and Apparatus held at the Imperial College of Science
and Technology, South Kensington, London, S.W.7, January 1st, 2nd
and 3rd, 1935. Pp. 192+lxii. (London: Physical Society.)

The Registrar-General's Statistical Review of England and Wales
for the Year 1933. (New Annual Series, No. 13.) Tables, Part 1:
Medical. Pp. iv+406. (London: H.M. Stationery Office.) 6s. net.

Forestry Commission. Report on the Demand for Timber for Box
and Packing-Case Manufacture in Great Britain. Pp. 47. (London:
H.M. Stationery Office.) 9d. net.

New Indicators and other Reagents Employed in Volumetric
Analysis. By Dr. Alec Duncan Mitchell. Pp. 21. (London: Institute
of Chemistry.)

Sheffield Public Libraries. Interchange of Technical Publications:
Union List of Scientific, Technical and Commercial Periodicals in the
Libraries of Members of the Group Interchange System. (For Members
only.) Pp. iii+83. (Sheffield.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 21
(N.S.), No. 14: The Chemical Constituents of Lichens found in
Ireland—*Lecanora gangetoides*, Part 1. By Josephine Hardiman, Dr.
J. Keane and Dr. T. J. Nolan. Pp. 141-145. (Dublin: Hodges, Figgis
and Co.; London: Williams and Norgate, Ltd.) 6d.

The University of Sheffield. Report on Research Work carried out
in the Departments of Mining and Fuel Technology during the Session
1933-1934. Pp. 24. (Sheffield.)

OTHER COUNTRIES

Australian National Research Council. David Lecture, 1933: Some
Founders of Australian Geology. Delivered at Science House, Sydney,
November 17, 1933, by Prof. Ernest W. Skeates. Pp. 24. (Sydney.)

Malta. Annual Report of the Working of the Museum Department
during 1933-34. Pp. xxv. (Malta: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial Uni-
versity. Vol. 36, Part 1: A Contribution to the Flora of the Aleutian
Islands. By Misao Tatewaki and Yoshio Kobayashi. Pp. 119+8
plates. (Tokyo: Maruzen Co., Ltd.)

Journal of the Faculty of Science, Imperial University of Tokyo.
Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3,
No. 8: The Cambro-Ordovician Formations and Faunas of South
Chosen—Paleontology, Part 1: Middle Ordovician Faunas. By
Teiichi Kobayashi. Pp. 329-519+44 plates. 3.50 yen. Vol. 3, No. 9:
The Cambro-Ordovician Formations and Faunas of South Chosen—
Paleontology, Part 2: Lower Ordovician Faunas. By Teiichi
Kobayashi. Pp. 521-585+8 plates. 1.00 yen. (Tokyo: Maruzen
Co., Ltd.)

Spisy vydávané Přírodovědeckou Fakultou, Masarykovy University
(Publications de la Faculté des Sciences de l'Université Masaryk.)
Čís. 191: Dvě Kruhové Plochy čtvrtého Stupně (Sur deux surfaces
cerclees biquadratiques). Napsal L. Seifert. Pp. 24. Čís. 192: Generis
Trigonella L. Revisio critica, Pars 2. I. Scripsit G. Širjaev. Pp. 15. Čís.
193: Sur les arcs indépendants dans un continu localement connexe.
Par Eduard Cech. Pp. 10. Čís. 194: Sur une équation fonctionnelle
de la théorie des probabilités (seconda partie). Par B. Hostinský.
Remarque sur un mémoire de M. Hostinský, par J. Potoček. Pp. 18.
Čís. 195: Anthropological Aspects of Blood Grouping. By Prof. V.
Suk. Pp. 9. Čís. 196: Hetero-Formiato-Soli Vápenaté (Hetero-
Formiato-Salze des Calciums), napsali J. V. Dubský a J. Trtlík;
Hetero-Sloučeniny Kyseliny Glykolové (Hetero-Verbindungen der
Glykolsäure), napsali J. V. Dubský a D. Vinogradová; Komplexní
Sloučeniny (MeX₂, 2A) a (MeX₂)H₂, 2A (Komplex-Verbindungen
(MeX₂, 2A) und (MeX₂)H₂, 2A), napsali J. V. Dubský a V. Dostál. Pp.
23. (Brno: A. Píša.)

Sborník vysoké školy Zemědělské v Brně (Bulletin de l'Institut
National Agronomique, Brno). Sign. C28: Agronomická pomoc
severního Irsku (Kritický Náčrt). Napsal Prof. Dr. Vladimír Štein.
Pp. 61. Sign. D22: Kuklice (Tachinidae) *Masarykova lesa*. Napsal
Dimitrij Jacentkovský. Pp. 38. (Brno: A. Píša.)

Department of Agriculture, Mauritius: Sugarcane Research Station.
Bulletin No. 4: Some Properties of the Sugarcane Soils of Mauritius.
By N. Craig. Pp. 35. (Port Louis: Government Printer.)

Dominion of Canada. Seventeenth Annual Report of the National
Research Council, containing the Report of the President and Financial
Statement, 1933-1934. Pp. 149. (Ottawa.)

Instituto Geográfico, Catastral y de Estadística. Anuario del
Observatorio Astronómico de Madrid para 1935. Pp. 328. (Madrid.)

U.S. Department of the Interior: Office of Education. Bulletin,
1934, No. 6: Teacher-Retirement Systems; Principal Provisions of
State Systems. By Ward W. Keesecker. Pp. v+46. 5 cents. Bulletin,
1934, No. 7: Bibliography of Research Studies in Education, 1932-
1933. Prepared by Ruth A. Gray. Pp. xiv+349. 25 cents. Pamphlet
No. 5 (revised): State-Wide Trends in School Hygiene and Physical
Education. By Dr. James Frederick Rogers. Pp. 15. 5 cents.
Pamphlet No. 51: Some Educational Activities for the Young Child
in the Home. By Rowna Hansen. Pp. 23. 5 cents. Pamphlet No.
54: Teachers' Problems with Exceptional Children, 4: deaf and
Hard-of-Hearing Children. By Beatrice McLeod. Pp. iv+29. 5
cents. Pamphlet No. 56: Teachers' Problems with Exceptional
Children, 6: Children of Lowered Vitality. By Beatrice McLeod.
Pp. iii+16. 5 cents. Vocational Education, Bulletin No. 174; General
Series. No. 5: Vocational Education and Changing Conditions;
Changing Economic and Social Conditions and their Effect upon
Vocational Education. Pp. v+112. 15 cents. Vocational Education,
Bulletin No. 101; Agricultural Series, No. 24: Analysis of the Manage-
ment of a Corn-Growing Enterprise; Managerial-Training Content of
the Type Jobs of an Enterprise of Growing Corn for Grain. Revised
1934. Pp. v+18. 5 cents. (Washington, D.C.: Government Printing
Office.)

U.S. Department of Agriculture. Circular No. 339: A Program of
Waterfowl Restoration. By J. Clark Salyer II. Pp. 11. 5 cents.
Technical Bulletin No. 421: The External Anatomy of the Parlatoria
Date Scale, *Parlatoria blanchardi* Targioni Tozzetti, with Studies of
the Head Skeleton and Associated Parts. By F. S. Stickney. Pp.
68+2 plates. 10 cents. Technical Bulletin No. 452: Experiments
with Nitrogen Fertilizers on Cotton Soils. By J. J. Skinner, R.A.
Lineberry, J. E. Adams, C. B. Williams and H. B. Mann. Pp. 28.
5 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 91, No. 18: Reports
on the Collections obtained by the First Johnson-Smithsonian Deep-
Sea Expedition to the Puerto Rican Deep—New Monogenetic Tre-
matodes from Marine Fishes. By Emmett W. Price. (Publication
3286.) Pp. ii+3+1 plate. Vol. 92, No. 10: Recent Discoveries of
Cambrian Beds in the Northwestern United States. By Charles
Elmer Resser. (Publication 3284.) Pp. ii+10. Vol. 92, No. 11:
Phototropic Sensitivity in relation to Wave Length. By Earl S.
Johnston. (Publication 3285.) Pp. ii+17+2 plates. Vol. 92, No. 12:
Remarkable Lightning Photographs. By C. G. Abbot. (Publication
3287.) Pp. ii+3+1 plate. Vol. 92, No. 13: The Standard Scale of
Solar Radiation. By C. G. Abbot and L. B. Aldrich. (Publication
3288.) Pp. ii+3. (Washington, D.C.: Smithsonian Institution.)

The Imperial College of Tropical Agriculture. Studies in West
Indian Soils, 8: The Agricultural Soils of St. Vincent. By F. Hardy,
C. K. Robinson and G. Rodriguez. Pp. 44. (Trinidad: Government
Printer.) 2s.

Bulletin of the National Research Council, No. 96: Selected Topics
in Algebraic Geometry, 2: Supplemental Report of the Committee
on Rational Transformations. By Virgil Snyder, Amos H. Black and
Leaman A. Dye. Pp. xii+84. (Washington, D.C.: National Academy
of Sciences.) 1 dollar.

Česká Akademie Věd a Umění (Académie Tchèque des Sciences et
des Arts). Třída (Class) 2: Anthropologica. Zpráva o Výsledku
Pátrání po Hrobě J. A. Komenského a jeho Tělesných Pozůstatků
(Rapport concernant le résultat des recherches entreprises pour
retrouver la tombe de J. A. Comenius et ses ossements). Napsali
Prof. Dr. J. Matiegka, Prof. A. J. P. van den Broek a Arch. Ing. Stan.
Sochor. Pp. 60+6 plates. Anthropologie Středo afrických Pygmějů
v Belgickém Kongu (Anthropologie of the Central African Pygmies
in the Belgian Congo). Napsali P. Sebesta a V. Lebzelter. Pp. 143+66
plates. (Prague: Česka Akademie Věd a Umění.)