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Biotechnology

IN an address to the University of New Zealand, referred to briefly in NATURE of April 15, p. 538, the Chancellor, Dr. J. Macmillan Brown, emphasised the need for building university education on broader foundations than the narrow specialisation which seems to prevail. Every degree, however specialised or technical, should have as its first stage the broadest culture possible. In this Dr. Macmillan Brown was only echoing a point of view stressed at greater length by Dr. Flexner in his well-known work "Universities: English, American and German", as well as by Prof. Findlay and others in recent addresses. The absence of anything like a true *universitas literarum* has long been lamented by close observers of our university life who have seen the dangers of the rapid development and inevitable specialisation, which result in young men of all countries being so immersed in their own special branches of science that they have scarcely the time or energy to devote to the study of more comprehensive problems.

The peril is indeed increasing, and the tendency to over-specialisation, to exclusive preoccupation with one small field of science, is definitely greater than a couple of decades ago. Even industry is suffering from the absence of perspective in the recruits which it now draws from the universities, and this the more in that, as the general cultural level falls, the demand for a sense of values and of perspective increases, industrial advance like scientific development originating more and more in the borderline sciences which are common ground to two or more of the great divisions of knowledge. Science is, after all, only one of the many civilised activities of mankind and inevitably suffers from any prolonged isolation from those other activities. The specialists' knowledge must therefore be supplemented by comprehensive surveys of the problems before science.

The value of such contributions, not merely to the understanding of the present position of science but also to the interpretation of the many difficult social, economic, and political problems with which our civilisation is confronted, is scarcely to be computed by those who have received no training in science. The need to-day is for those who can truly interpret the values of human life, and recent literature testifies not merely to the capacity of the man of science to assess such values, but also to the indisputable fact that when

he is freed by a broad culture and outlook from the restraints of a narrow specialisation, he forms such judgments of value like all other men, and that indeed to become an investigator demands a certain sense for judgments of value. Moreover, even in specialisation at its worst, the man of science has learnt to discard the dogmatism with which he so justly reproached the theologian of a former generation, but with which he was frequently strongly tainted himself.

The change which has come over science in this respect can scarcely be attributed to the tendency of scientific laws, even in modern chemistry and physics, to assume the character of average or statistical laws, or even to the convergence of scientific investigation. It may be due in part to the realisation that the classification of the sciences is largely arbitrary and inadequate—that differences existing between physics and history or biology, for example, are mainly in the complexity of the material and not in the method. Human actions in history are so overwhelmingly complicated that general laws are much more difficult to discover, and consequently to apply, than are physico-chemical laws. It may be due, further, to the recognition that it is fundamentally wrong to believe that we now hold in our hands the absolute and final truth in any category value. As Einstein has said, every scientific theory can be, and needs to be, merged in a higher and more comprehensive theory from which it finally receives its limits.

On the other hand, if the limitations of science are now more clearly perceived, it is also true that the tacit assumption behind the whole of scientific knowledge—that knowledge is possible concerning an objective set of facts, in other words, that there is such a thing as truth—has become more and more unassailable. We are indeed leading up to a final condition of physics in which all past discoveries are comprehended in a single unitary logical structure which is independent of the various possible methods of approach.

An outstanding feature of the present position is that we are now able to state very exactly where lie the problems still to be solved, and the chances of a really fundamental new discovery by random experiment or purely speculative theorising are well-nigh negligible. All really great theoretical and experimental discoveries of the last decade have been made by trained specialists, and in the main by men who had long reached the highest eminence in science. This position does not indeed entitle us to believe that investigation in this field is likely to become stagnant. It may, on the contrary, begin deductively in greater earnest. It does, however, provide some real explanation of the strong plea for the concentration of effort on the human sciences, where the greater complexities have delayed advance to a comparable extent and where the true laws have largely to be discovered.

To grant this is not to concede that the sole object of science is to understand the present state of affairs ; its goal is rather the whole course of events in the past, present and future. What is clear to even the most casual observer is that man's development has been unbalanced. His knowledge of physical laws and his control over physical forces is out of all proportion to his knowledge of biology or of the sciences concerned with man, still more with the growth of ethics and morality. For example, it is well known that there are inherited differences in cultural endowment among the members of a people, and these endowments are on an average proportional to the social level of the various layers. It is equally well known that in all modern civilised nations the relative increase in population is inversely proportional to the social level. The corollary that the civilised European nations are allowing their leading cultural elements to die out is, however, not generally faced. Few grasp the extent to which our modern social, hygienic and educational measures promote the well-being of the individual at the cost of humanity. The future of the world lies with the race that is the first to apprehend the true causes of cultural decay and to resolve to eliminate these causes.

At this point we touch an ideal characteristic of our modern Western civilisation—the technical ideal of fitness for a purpose for its own sake. This ideal, as distinct from mere utility, is behind much of the opinion urging the rationalisation of industry, the movement for scientific management, for scientific administration. It is in the direct succession of the ideal of pure science, the discovery of truth for truth's sake—a late conception in the development of humanity. In the technical ideal the fact that elimination of waste of material or effort, for example, in bridge building, involves a saving in cost is purely secondary if not irrelevant. Construction to fulfil the technical ideal must achieve the best possible result with the least possible means. To state, therefore, that technology demands the fulfilment of a purpose by the most

suitable means and that quite commonly it consists in the choice of the correct means to achieve that given end, is to realise the immense significance of technology for every side of our social life to-day and the value of liberating it from a mere pecuniary conception of the principle of economy.

It is incontestable that, even in this narrow sense, technical progress has been of immense economic advantage to the world and has raised the average standard of living very considerably. Moreover, the regrettable results of industrialisation and the mechanisation of industry are less the direct responsibility of technology than of economic developments connected with particular technical achievements. None the less, profound problems are raised at this stage. It is possible that wise statesmanship may yet avert the worst consequences of such economic developments by foresight and appropriate action. In particular, there is the problem of leisure and how far it can be utilised to balance the mechanising influence of work and those other influences which perpetuate or increase the ratio of undesirable work.

The whole effect of technology upon our spiritual and mental life has yet to be examined. Once we accept the facts that the advance of science, both pure and applied, and the command of man over Nature cannot be resisted, we are compelled to face the problem how such developments can be made to conform to the elementary spiritual needs of mankind, which themselves cannot be abolished by simple decree.

Aeroplane and Camera in Anthropological Fieldwork

Äthiopen des Westens: Forschungsreisen in Portugiesisch-Guinea. Von Hugo Adolf Bernatzik. Mit einem Beitrag von Bernhard Struck. Band 1. Pp. xii + 303 + 12 plates. Band 2. 152 plates. (Wien: L. W. Seidel und Sohn, 1933.) 135 gold marks.

To state that "Äthiopen des Westens" is a sumptuous production is not to exaggerate the lavish feast which this beautifully produced work unfolds to the eye. To write that the 531 plates—400 of which form the sole contents of vol. 2—comprise the *pièce de résistance*, is not to belittle the narrative matter which constitutes the greater part of the text of vol. 1.

Dr. Bernatzik has summoned the camera and the aeroplane to be his interpreters in his successful attempt to portray the life of the inhabitants of little-known Portuguese Guinea. The result is, very literally, a vivid series of pictures of the peoples among whom he travelled. Prof. Struck's contribution supplies—what may have been deemed the necessary—more strictly scientific touch. It deserves special notice which it will presently receive.

This must surely be the first occasion—if we omit Lady Bailey's survey flights in North Africa, and the solo flight over the Gold Coast of a professional anthropologist in 1929—upon which the aeroplane has been called in to assist the anthropological field-worker. Perhaps only those who know the ever present and dread possibilities of forced landings when flying over tropical forests, can fully appreciate the skill and courage of the air-woman, Fraulein Elli Beinhorn, which made possible the many bird's-eye views of native houses and homesteads. Dr. Bernatzik's methods were, throughout, simple and straightforward. Handicapped by a lack of knowledge of the local vernaculars, he was compelled to rely more on what he could himself observe than on what he heard or was told. He has taken each of some dozen tribes in turn, and under such headings as religion, birth, marriage, funeral rites, dances, law, love-making, etc., has described what any trained and careful observer would be likely to see with his own eyes. He has then recorded these sights and scenes with the aid of an artistic wife and of a fine camera. The rites and customs which he describes exhibit many of the features which we are now beginning to find common to most West African primitive societies, the more we come to know about such communities. Ideas on land tenure; law; standards of morality, where the desire for children far outweighs any narrow jealous feeling of sexual prerogative on the part of a childless spouse; the absence of chiefs—in the narrower territorial sense—all these and many other customs described are found among other west coast peoples.

One statement, however, made by Dr. Bernatzik seems so extraordinary as to merit some doubt as to whether he has not either been misinformed or misled. He writes, speaking of the Balante, that they do not believe in a life after death; that they do not follow the cult of ancestor worship, that they do not fear the dead. All this, too, in West Africa, where the cult of ancestors is the keystone of all religious beliefs. It seems well-nigh impossible.

The reviewer was struck with the old priest's description of a great tree which had withstood a forest fire for twenty days, standing up when all around it had been destroyed, "a mighty glowing column", thus justifying and augmenting its previous claim to divinity. The story recalled vividly a similar spectacle which the writer once saw in West Africa. Wandering in the forest one misty morning, he saw through the harmattan haze an immense column of incandescent radiance, towering some 250 feet into the sky. The sight was so wonderful and uncanny as at first to inspire a feeling akin to awe. This strange phenomenon proved, however, on closer inspection to be only a gigantic tree, which from base to summit was a white-hot mass of glowing charcoal. It emitted neither smoke nor sparks but shimmered with a white heat. After witnessing such a sight, it is not difficult to understand how a blackened tree stump may have become a pagan god.

Reference has already been made to Prof. B. Struck's contribution to this work. His chapter on physical measurements may be said to supply the more strictly scientific background for Dr. Bernatzik's more simple narrative and wonderful pictorial setting. The social anthropologist has here asked the physical anthropological expert to come to his aid in order to do full justice to this important part of the work under review. Dr. L. H. Dudley Buxton writes as follows :

"Prof. Struck's contribution to the physical anthropology of this region, which is little known, is a very important one. The author gives a careful reference to the methods used—a precision unfortunately only too rare. He always prints the numbers of the definitions given in Martin's 'Lehrbuch' ; in particular, he directs attention to the question of the position of the nasion, in which case Martin's method is adopted, it would appear, with some reluctance. On this very important point, for the nasal index is extremely significant in many parts of the west coast, the author seems satisfied on internal evidence, namely, the comparison between the various groups, that he was working consistently with others in the field. To the critic who is constantly faced with the doubt as to whether the work of different observers is comparable, Prof. Struck's paper is for all these reasons extremely welcome.

"There are, however, some points to which criticism may be fairly directed. No one knows better than the field-worker how very difficult it is to get adequate numbers of subjects, and in most cases the author's groups are sufficiently large for satisfactory comparison. On the other hand, it would be a hazardous undertaking to base any conclusions on the comparison of groups which contain only a few individuals ; it would perhaps have been safer with our present knowledge, either simply to publish the means of the smaller groups without drawing any deductions, or, where it is possible, to use the method followed in the case of the Balante and Pepel and to pool the subgroups, where there is reason to believe that such a pooling is justifiable. Next, it would seem inadequate merely to publish means ; the constants of variation and probable errors should certainly be added, especially where comparisons between individual measurements are made. The author's method is to consider each measurement individually, and to compare the various tribes.

"Much as one might have wished for a general summary, obviously the material was inadequate for this and the restraint of which this absence is evidence is not the least commendable part of a paper which should be of very great value to all students of the physical types of West Africa."

R. S. R.

The Trinkler Expedition to Central Asia

Geographische Forschungen im westlichen Zentralasien und Karakorum-Himalaya. Von Dr. Emil Trinkler. (Wissenschaftliche Ergebnisse der Dr. Trinkler'schen Zentralasien-Expedition, bearbeitet von Dr. E. Trinkler und Dr. H. de Terra, Band 1.) Pp. viii+134+16 plates. (Berlin : Dietrich Reimer (Ernst Vohsen) A.-G., 1932.) 32 gold marks.

Geologische Forschungen im westlichen K'unlun und Karakorum-Himalaya. Von Dr. Hellmut de Terra. Mit Beiträgen von G. Fischer, W. Gothan, P. Vinassa de Regny, O. H. Schindewolf, J. Schuster, K. Staesche. (Wissenschaftliche Ergebnisse der Dr. Trinkler'schen Zentralasien-Expedition, Band 2.) Pp. x+196+22 plates. (Berlin : Dietrich Reimer (Ernst Vohsen) A.-G., 1932.) 44 gold marks.

THE name of Dr. Emil Trinkler must be added to the growing list of those who, having risked health and life itself in the cause of science in distant lands, have fallen victims to the perils of modern civilisation. T. Alexander Barns, after years of exploration in Central Africa, was killed in a motor accident in Chicago ; Dr.

Trinkler, after such narrow escapes from disaster in the uninhabited Kunlun as when all but one of his yaks perished, also died as the result of a motor accident—in Bremerhaven in April 1931. He was but a young man of thirty-five years when he died but he has left behind a record of solid work which will remain as an important contribution to the elucidation of the structural and morphological history of the Karakoram, Kunlun and Taklamakan regions.

Dr. Trinkler first became prominent as having made a lengthy tour through Afghanistan in 1923. He showed himself a man of resource in travel and of sound ability in the marshalling of facts and sifting of evidence collected by his predecessors. As a result his "Afghanistan, eine landeskundliche Studie" (J. Perthes, Gotha, 1928) is a standard work on the country. His second and more ambitious journey, undertaken in 1927–28, was preceded by a careful study of the work of previous explorers in the Eastern Karakoram, and so he was able to select a region that had been comparatively neglected. From Leh in Kashmir he followed an eastern route across the western end of the Tibetan plateau to the Kara-Kash River; over the Kunlun to the Taklamakan depression. After considerable journeys there he returned to Leh by the better-known route of the Karakoram Pass. By choosing this circular route the geological results include a complete double traverse of the Karakoram and Kunlun chains, whilst the leader was able to make a special study of one of the problems he regarded as of special interest—the history of glaciation in this region.

Dr. Trinkler wrote a popular account of his journey, "Im Land der Stürme" (F. A. Brockhaus, Leipzig, 1930) and a number of technical papers. The latter include two in English—his conclusions relative to the Ice Age (*Geog. J.*, 75, 225–232; 1930) and a general account of his journey (*Ibid.*, 75, 505–517; 1930). His detailed account of the geographical observations was almost ready for press at the time of his death and so has appeared posthumously, edited by Frau Ilse Trinkler and G. Köhler. For this thanks are also due to Dr. H. de Terra, the geologist of the party, who was a fellow student of Trinkler's at Munich and is now research associate in geology at Yale. Simultaneously, Dr. de Terra has published his geological observations; the archæological results of the expedition, which are being worked out in the Bremen Museum, have still to appear.

(1) The geographical volume is divided into two parts. The first deals with the mountain belt between the Upper Indus valley at Leh and the Tarim Basin; the second with the western part of the Tarim Basin itself. In the first part the features observed on each stage of the journey are described in sequence with the help of sketches and photographs. A number of the latter are by W. Bosshard, a Swiss, who formed the third European member of the expedition. Special attention is given to morphology and a contrast drawn between the accidented topography of the Tertiary ranges and the round outlines of the hills which rise from the surface of the Tibetan plateau.

It is a legitimate presumption that when the great Ice Age covered the whole of Northern Europe and the northern parts of Northern America with ice sheets, Central Asia should also have been the seat of a huge ice-sheet. A review of the evidence leaves no doubt that the glaciers of the Kunlun, Karakoram and Himalayas were formerly much more extensive. Dainelli, who accompanied the Italian expedition led by De Filippi in 1913–14, found evidence in the Karakoram for four great glacial periods corresponding with the Mindel, Riss, Würm and Post-Würm stages in the Alps. Although the moraines of the first two glaciations are poorly preserved, Trinkler does not appear to doubt this interpretation. He considers that during the later glacial periods the snow line was 2,000–3,000 ft. lower than at present and that glaciers descended in the Kunlun to 8,000 ft. or 9,000 ft. above sea-level. It may even be that Dainelli is right in believing that the big Indus glacier ended with its snout in the lake which formerly occupied the Attock plateau of the Punjab at less than 2,000 ft.

Whether the great Tibetan plateau, the roof of the world, was covered by a huge ice-sheet is, however, another matter. The temperature was, of course, low enough, but did not the southern ranges—the Himalayas—intercept the moisture-laden winds just as they do to-day and prevent sufficient precipitation? Trinkler admits that striated boulders and polished rocks are extremely rare, but points out that disintegration of exposed rocks is very rapid owing to the strong insolation. Further, typical V-shaped valleys are absent on the plateau. Trinkler therefore comes to the same conclusion as Prinz did in the Pamirs, that the broad valley-plains of the Tibetan plateau were

more or less filled with *stagnant Tafeleis* (Highland ice) which left little trace on melting. Only on the margins where movement was possible did it carry out the work of erosion characteristically associated with ice-sheets. In connexion with precipitation on the plateau, it is interesting to note that Trinkler asserts positively that the Indian monsoon penetrates far into the interior, though winter snowfall is also brought by depressions from the west.

(2) Dr. de Terra has secured the collaboration of a number of experts in preparing his volume on the geological results of the expedition. He gives a brief introductory outline enumerating the orographic units and then proceeds to a detailed account of his observations. Especially valuable are the numerous sketches and simplified block diagrams illustrating the relationships between structure and topography. A coloured map on the scale of 1 : 1,000,000 is included and on p. 112 the author attempts two generalised sections from Leh to the Kunlun. Three distinct belts stand out clearly : (1) the highly folded Himalayan-Mustagh or Karakoram belt in which gneisses, schists, metamorphosed older Palæozoics and intrusive granites predominate ; (2) the highly folded Kunlun belt where again gneisses and granites play a very large part ; and (3) the intervening belt of plateaux in which gently folded Triassic limestones predominate but where younger Palæozoic (Carboniferous-Permian) as well as Cretaceous rocks are also present. The last belt formed part of the Tethsy until late Cretaceous times.

There is, of course, an important distinction between the Himalayan fold-belt in which Tertiary rocks are involved and the Kunlun fold-belt, folded and uplifted in Permian times. The old Kunlun system, Dr. de Terra discovered, is separated from the geologically younger folded regions of the Tibetan plateau by a belt of faulting which is marked by a broad plain-like valley running along the southern foot of the main Kunlun range. In general, both in the Kunlun and Karakoram, tectonic and orographic strikes correspond.

The latter part of de Terra's volume is occupied by a description of hand specimens and fossils. Both Dr. Trinkler and Dr. de Terra have much of interest to add to what is already known of the Taklamakan, but their contribution to the knowledge of the mountain wall which separates India from Chinese Turkestan is of outstanding importance.

L. Dudley Stamp.

Hydro- and Aerodynamics

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4 : *Hydro- und Aerodynamik.* Teil 4 : *Rohre, Offene Gerinne, Zähigkeit.* Herausgegeben von Ludwig Schiller. Bearbeitet von L. Schiller, F. Eisner, S. Erk. Pp. viii+719. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1932.) 67 gold marks.

THIS fourth and concluding volume of the part of the "Handbuch der Experimentalphysik" devoted to the subject of hydro- and aerodynamics fully maintains the high standard set by the three preceding volumes. It comprises three long articles dealing respectively with the flow in pipes, the flow in open channels and the measurement of viscosity, and it also contains a useful general index to the whole four volumes.

The first article, by Prof. L. Schiller, is noteworthy for its critical discussion of the subject and for its clear exposition of both the theoretical and experimental investigation of the flow in pipes. The work of Schiller himself and that conducted under his direction at Leipzig have contributed greatly to our knowledge of this subject and in particular to a proper understanding of the influence of different entry conditions and their effect on the pressure loss along a pipe. After a clear exposition of the principles of dynamical similarity and of the precautions necessary in the measurement of velocity and pressure, Schiller discusses in turn the laminar and turbulent flow in circular pipes and transition from one type to the other. An excellent and valuable summary of the best experimental results is supplemented by a discussion of the latest theoretical developments, in which turbulent flow is analysed on the basis of Prandtl's conception of a *Mischungsweg*. The article concludes with relatively brief discussions of the flow in non-circular, divergent, curved and rough pipes.

The flow in open channels is discussed by Dr. F. Eisner in the second article. This subject is far more complex than the flow in pipes owing to the presence of the free surface, the conditions for full dynamical similarity are more complex and indeed prevent any exact model experiments, and the problems tend to assume a practical engineering rather than a scientific aspect. After a rather tedious discussion of the conditions of dynamical similarity, Eisner gives a valuable account of the experimental technique and apparatus with special

attention to the determination of the form of the free surface. This is supplemented in a later section by descriptions of the ingenious devices used for creating tides and waves. The major part of Eisner's article is, however, devoted to a detailed description of experimental results covering a wide range of subjects, and particular mention may be made of his excellent account of wave motion.

The third article, by Dr. S. Erk, deals with the measurement of viscosity. Numerous types of viscometer, suitable for different fluids and different experimental conditions, are fully described, and the experimental results for a large variety of gases and liquids are then tabulated and discussed in the light of existing theories. The article concludes with a brief account of the methods of measuring the viscosity of solid bodies. The treatment of the subject is throughout clear and comprehensive, but there are unfortunately several incorrect references to tables and figures.

A Treatise on Coordinate Geometry

Elements of Coordinate Geometry. By J. M. Child. Pp. xiii+468. (London: Macmillan and Co., Ltd., 1933.) 12*s*. 6*d*. net.

THE outstanding feature of this substantial treatise on coordinate geometry of two dimensions is the full and elaborate account which it gives of the theory of the subject. In consequence, the volume should prove a useful manual for students preparing for scholarship and honours degree examinations.

The first chapter contains a discussion of the representation of real numbers by points on a directed line; and this, naturally, raises the problem of the irrational number, which Mr. Child defines by means of sequences of rational numbers. Curiously enough, he does not point out that the number so defined may be rational. It must be confessed that his phraseology in dealing with limits is somewhat loose.

Before introducing the equation of the straight line, Mr. Child devotes a chapter to the plotting of statistics. He defines the positive direction of the straight line as that in which x increases. It is doubtful if anything is gained in coordinate geometry by giving direction to the straight line. The direction makes no difference to the gradient formula, on which the theory of the straight line can most simply be based.

Useful features of the book are the very full discussions of the general equation of the second degree and the sections on polar coordinates. The treatment of tangents, based on the theory of monotonic sequences, is interesting, though it scarcely seems necessary to bring in the idea of 'time'.

Later chapters deal with conics, cross-ratios, the "line at infinity" and homogeneous coordinates. The book is intended to stress the advantage of coordinate geometry as "a powerful analytical weapon of attack" and consequently the pure geometry of conics is only dealt with incidentally. Here and there interesting historical notes are given, and there are plentiful collections of examples, of varied difficulty, with answers supplied. T. M. M.

Short Reviews

The Life Histories of New Zealand Birds. By Edgar F. Stead. Pp. xvi+162+93 plates. (London: The Search Publishing Co., Ltd., 1932.) 30*s*. net.

IN this book we have Mr. Edgar F. Stead doing for New Zealand birds what Mr. Arthur C. Bent is doing for American birds. Each is an expert and the result is a great gain to knowledge.

In New Zealand we find the evil of man's introduction of the stoats and weasels. The birds, which never before had this enemy, now find life made hard for them. Amongst the waders we find a detailed account of the double-banded dotterel, so common in New Zealand and Australia, but breeding only in the former country. Its migration, north to Norfolk and Lord Howe Islands then to the east coast of Australia and so on to south-west Australia, is one of the extraordinary movements amongst birds.

We find now that the black fan-tail is only a variant of the pied one; mated birds produce the pure black bird and in the same nest, pied birds, as many workers have contended.

Under the shags we find the old superstition that these birds are the fisherman's enemy and destroy fish that he should catch. New Zealand has many shags, most of them very common indeed, yet more fish are caught each year than in the previous one. The skua, with its bad reputation, here as elsewhere, is given an autobiography in spite of its depredations on the delightful mottled petrel.

The splendid plates add greatly to the charm of the book, and the author's pleasant style of writing

will attract the reader, who will be interested and instructed while reading the book. It will be a useful and necessary companion to Oliver's book "New Zealand Birds" which we reviewed last year. At the end of the book is a description of the eggs of the eighteen species of which the life histories have been described.

Handbuch der Vererbungswissenschaft. Herausgegeben von E. Baur und M. Hartmann. Lief. 15 (Bd. 3, L): *Entstehung der Kulturpflanzen.* Von E. Schiemann. Pp. ix+377. (Berlin: Gebrüder Borntraeger, 1932.) 50 gold marks.

This textbook endeavours to present a comprehensive review of the origin of cultivated plants, considered from the historical and biological points of view. The preliminary general discussion deals with our historical knowledge of the various crops, after which comparative morphology, geographical distribution and genetics are considered in their relation to crop plants. The range of the inquiry is wide, embracing in addition morphology, physiology and problems of variability. Where a crop plant occurs in both wild and cultivated forms, it is pointed out that its origin is usually to be sought where the wild type occurs.

Individual crops receive separate treatment, most of the common agricultural plants such as cereals, potatoes, Leguminosæ, etc., and a few of the more important horticultural crops as tomatoes, fruit, grapes, etc., being discussed in detail. A full bibliography of some twelve hundred titles, and tables giving a general summary of the main results, round up a most useful work of reference.

The Gestalt Theory and the Problem of Configuration. By Bruno Petermann. Translated by Meyer Fortes. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xi+344. (London: Kegan Paul and Co., Ltd., 1932.) 15*s.* net.

Among the psychological theories, the doctrine of *Gestalt* or 'configurationism' has won general attention only recently, though it grew contemporaneously with behaviourism. Its importance, however, is none the less very great in so far as it furnishes an alternative approach to the psycho-physiological problem of human and animal behaviour. The general conception of 'configurationism' is to stress organised wholes as they occur in experience and in performance rather than their elements, as does the older psychology. This method makes possible an alternative treatment of behaviour, of perception and even of learning, though the results obtained in this respect are not yet final. The particular value of the book under review is that it not only explains the aims, method and results of the *Gestalt* theory, but that it also makes a searching criticism of this doctrine, indicating at the same time the conditions for its future progress.

T. G.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Frank C. Whitmore, Editor-in-Chief. Vol. 12. Pp. vii+96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

The latest volume of this series contains details of the preparation of thirty useful substances. Among them are *p*-chlorobenzaldehyde, *p*-tolualdehyde, desyl chloride, succinic anhydride, mercury di-β-naphthyl, and diethyl zinc. The preparation of 2,4-dinitrobenzaldehyde (a reagent of value for characterising amines and substances with a reactive methylene group) is a particularly interesting process, depending upon the reaction between *p*-nitrosodimethylaniline and 2,4-dinitrotoluene, whereby the methyl group of the latter substance is eventually transformed into an aldehyde group, leaving *p*-aminodimethylaniline as a by-product.

This issue is the third volume not embraced in the recent collective work, and it is therefore useful that the index to vol. 12 has been extended to cover the contents of vols. 10 and 11 also.

J. R.

L'Année psychologique. Publiée par Prof. Henri Piéron. Année 32 (1931). Vol. 1. Pp. xx+480. Vol. 2. Pp. 481–949. (Paris: Félix Alcan, 1932.) 120 francs.

As usual, this yearly publication contains some very important original essays and a mass of reviews (1,670 in number) of the current literature of psychology. It will suffice to mention some of the subjects treated: chromatic sensation (Piéron), mental work without movements (Foucault), nervous rhythms and relaxation oscillations (Fessard), complexity of consecutive visual impressions (Durey), appreciation of time in the white mouse (Ruch). At the end of this work there is an appeal by Prof. Spearman, to the effect that psychologists should agree once for all about the conditions and interpretations of certain experiments, on the lines followed by physicists.

A French-English Vocabulary in Geology and Physical Geography. By G. M. Davies. Pp. ix+140. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1932.) 6*s.* net.

This vocabulary contains between four and five thousand words. Most of them are either technical terms or words in common use which have special technical or colloquial meanings. The inclusion of the English equivalents of a number of unfamiliar place names adds to the usefulness of the vocabulary. An appendix contains a comparative table of English and Continental stratigraphical terms. The lack of such a glossary as this, devoted especially to geology and its allied sciences, has long been apparent. It should prove invaluable to many English readers of French works on geology and geography.

Agriculture and Milk Supply*

By Prof. Henry E. Armstrong, f.r.s.

"Nought shall make us rue
If England to itself do rest but true."

WE take our time in minding the Bastard's advice—concerning ourselves more with Far Eastern questions than with our own, even with such minor, polar moments as hard hitting above the cricket belt and dog totes. In fact, our one popular use of our land is playing games upon it: also as gladiators but upon rubber tyres and oil-fouling our tracks as we go, mercilessly and without turning down of thumbs running each other down, under sanction of third party insurance! Those who set themselves over us, by right of caucus, have long ceased to think of the land in constructive, sympathetic terms or otherwise than as affording opportunity for the greatest of all games—taxation! Agricultural research is become an underground business, with little interest in sun-bathing; dealing with bacteria mostly—a form of life to which, ultimately, we must all succumb. In Egyptian times, some care was taken of our bodies—to-day we are simply handing them over to commercial exploitation: to universal undertakers called canners. We calmly cut our food not from the joint with two vegetables but out of sealed 'coffins'. Fresh food will soon be unseen and unsold! Health must steadily deteriorate. We call the game we are fatuously playing—Progress; perchance, the name will ere long perforce be changed to Perdition. Well may we ask with Bunthorne:

"Is it and can it be
Nature hath this decree
Nothing poetic in the world shall dwell?"

Nothing natural? Is our agriculture coming to an end?

The issue I would raise is—*Are we to use our land to produce fresh whole food—to make ourselves a whole people, our animals whole stock?* Alternatively, are we to allow tubercular disease, cancer, appendicitis, foot and mouth—deficiency diseases generally—to ravage our population? Malnutrition to prevail everywhere? Is our land to be highly fed and used up to the hilt of production and employment or is it to go derelict—to favour machinery and commercial lust? Many industrialists would calmly put the countryman aside—just use him to keep the hedges trim; so that they may sell their wares abroad, they would allow unconditional free entry to other people's farm products without reference to quality. Such form of civil war is even looked upon as a means of cementing family ties: it was at Ottawa. In the sacred name of Imperial Preference, we are to allow our wheat to be grown in Canada and Australia, our milk to be made in New Zealand! Our eggs and butter also at the Antipodes. As to meat, we help in every way its introduction into our markets, in merciless competition with that raised upon our own soil: under the ægis of the Department of Scientific and Industrial Research, public funds are lavishly spent on the study of the means of preserving it and other food, so that they may be brought to us from long distances. Home produced food materials receive little scientific attention.

The fault lies with our own fraternity of science, in that we have in every way aided commercial, industrial development, without considering the ultimate effect upon the general welfare. No proper social use has been made of knowledge—the national education has been and still is in the hands of people who have no eyes to see and but play with words: the Head of Eton becomes Dean of Durham. We are still under monastic rule.

"New times demand new manners and new men."

The cry was uttered long ago by an American advocate of freedom. The men who would lead the world to-day are old and without any manners that are new: they have no regard for the method of discovery—the one gift the world has received in modern times; unfortunately, by unrighteous and partial use the gift has brought the world to its present intolerable position.

A decision must soon be taken—what proportional share and part agriculture is to have in our social economy. That we must play the game with our land cannot be denied. It is the only ultimate asset we shall have, as an island people, if and when all else fail us. To maintain a fit and happy race, we must needs preserve a rural population. Prices must be established at such agreed levels that we can make most use of men and least use of machines. It cannot be that we shall sink so low, through commercial avarice and worship of the unholy doctrine of always buying in the cheapest market, that we shall decline to use to the full the great God-given machine that we have in the sun. Chemistry forbids: the forgotten law of the conservation of energy. Manufacturing industry is but dissipation of energy, when carried on with coal.

To-day, the chemist can have but one opinion, if he consider the needs of the world. This is, that the first use we make of our science—of scientific method—should be on behalf of our food supply, in farming. Thus far, the farm has been considered from the point of view of a far too narrow economics—commercially and statistically, in terms of output. So great, however, has been our progress in the scientific study of food problems, especially during the past twenty years, that we are now able to envisage the place and object of agriculture from an entirely new angle: *that of nutritive value.* We know that malnutrition prevails the world over.

The future fulcrum of our agriculture must undoubtedly be milk—the food of foods, the food

* Ministry of Agriculture and Fisheries. Report of the Reorganisation Committee for Milk. (Economic Series, No. 38.) Pp. 228+xx. (London: H.M. Stationery Office, 1933.) 6*d.* net.

of infancy, the one and only complete food known to man. America is far ahead of Great Britain in its appreciation and use of milk. Here, the medical profession has never properly encouraged its use—being so deadly afraid of the organism provocative of tubercular disease. There has been no public opinion on the subject and too little attention has been paid to quality: although, of late, there has been a marked improvement, none the less, the average quality is far too low.

So far are we from being alive to the need of using scientific method and knowledge in the service of the State, that only laymen were appointed by the Ministry of Agriculture, as members of the special commission the Report of which on the Reorganisation of the Milk Supply has recently been issued. Only commercial organisation is considered, though measures against the spread of disease are recommended: these involve the appointment of fresh veterinary inspectors, doubtless with power to order the slaughter of infected animals. Hitherto, the Ministry of Agriculture, unfortunately, has had only one remedy in mind, in dealing with cattle disease—to kill. If it had charge of the community, it would re-Herod Herod and order all children with measles to the destructor—as it does cattle with foot and mouth disease. Preventive vaccine treatment also is at best a palliative. We need to put Pasteur aside and start afresh: having learnt something since his day, the time is come to go forward with constructive ideas of our own. The more we rely on pasteurisation, the less we are likely to go forward with measures to place our milk supply upon a scientific basis.

It is useless to shut the stable door after the steed is stolen, even in dealing with tuberculous cattle. Assuming that the organism were gone from milk, the ever-present far greater danger of the pulmonary form of the disease would remain. It is impossible to kill off the contacts: you can only cure victims at high cost—but how? Definitely, by high feeding!

Why not apply the cure to prevent the disease? The one chance of eliminating tubercular and other zymotic diseases seems to be to feed them out—both from cattle and ourselves. Let us seek to feed both our cattle and ourselves with whole food, rich in all the advitants. We know that there is disease whenever one or more of them is absent. In one region in New Zealand the animals suffer from a recognised deficiency in iodine: in another, from lack of iron. Ours often suffer from want of available iron; in sandstone regions especially the effect of a deficiency of lime and perhaps phosphate is particularly noticeable in the poor development of the horns; calcium is undoubtedly lacking over large areas. Australian and South African soils are known to be greatly deficient, particularly in phosphate, potash and lime. The produce from these countries must often be deficient in quality, on this account.

Proof has been obtained, from numberless experiments on animals, that health is greatly influenced by feeding and that properly fed animals are little if at all subject to bacterial infection. Minor deficiencies may not be easily followed up but, in the long run, their effect may be deep seated. The experiments made with pasteurised milk are all suspect, if only on this account; valid results cannot be obtained with children. Just as milk has been taken to be worthy to be called milk, if only it came from a cow, even from a tuberculous animal, after pasteurisation: so grass was long taken to be grass, if only a cow would eat it; only when it came to fattening animals, was a distinction made. The most important of all cereals, grass has been the least studied: no imagination has been put into the foundations of milk. The Rothamsted plots, however valuable botanically, have taught nothing of grass as a fodder crop. All we know is that grass needs to be treated as well as wheat. Not until the War and in Germany was inquiry directed to the use and special value of nitrogenous fertilisers on its growth. The great value of young grass was then brought to the fore.

In the last few years, inquiries into the growth and use of grass have been carried out in various parts of England, for the production of milk, under the direction of Sir Frederick Keeble, formerly professor of botany at Oxford. The results are in part described and discussed in his book "Fertilizers and Food Production on Arable and Grass Land", a work of great interest, nothing short of a revelation of grass.

One of the most significant results is that obtained last year by the winter feeding of cows with grass, cut young in the summer and forthwith rapidly dried, the grass being taken from pasture fully fertilised with minerals and also with an ammonia salt. Comparison was made with a grass from an adjoining pasture to which no nitrogenous manure had been applied, only minerals. The milk from the cows fed on the 'nitrogenous grass' gave a butter of full summer value in appearance and character; the butter from 'minerals only' was but slightly better than the poor product ordinarily obtained from stall-fed cattle. The result is as striking as that shown at Rothamsted on the celebrated Broadbalk Field, on the two plots, both fully dressed each year with minerals, one or the other only receiving nitrogenous fertiliser each year. Without nitrogen, the crop each year goes down nearly to the level of the nearby permanently unmanured plot.

During last winter, I was able to initiate an experiment with young boys, with the object of determining whether milk, produced with the aid of such summer-cut dried grass, be of special food value compared with the ordinarily 'stall-fed' milk. It is too early to pronounce upon the result but I have been astounded at the way in which the cattle fed upon the dried grass are 'swelling visibly', like 'the Fat Boy', in comparison with their neighbours. The carotene content of the milk is at a high level. Who shall say what other components may not be equally affected? It is

impossible to believe that improvement is in one necessary component only.

With such evidence before us, the way is clear: selfishly, to care for our cattle as much as we care for ourselves: in fact, through them really to care for ourselves, particularly for our children. Housing is of no importance compared with proper feeding.

The supreme value of milk is beyond all question —particularly to the pregnant mother, to the child from the moment of conception, throughout infancy and early youth. Our task now is to make the general supply of such quality that it may serve as a defence against all disease arising in any way from a lowered vitality in ourselves or in farm animals generally from imperfect feeding.

Our cry should be not merely: 'Back to the Land' but 'Honour the Land', by raising its fertility to its fullest extent and enjoying the fruits thereof.

The Indian Institute of Science, Bangalore

THE retirement of Dr. M. O. Forster last month from the directorship of the Indian Institute of Science, Bangalore, after ten years service, and the appointment of Sir C. V. Raman to succeed him, afford an appropriate opportunity to give a general account of this remarkable Institute and its work. In recent years the number of workers in the various departments has greatly increased, and many of the researches carried out by them are of high scientific value, while others have a direct bearing upon the development of the country's natural resources and industrial expansion. There are four scientific departments in the Institute, concerned respectively with general chemistry, organic chemistry, biochemistry and electrical technology, and the range of investigations carried on in each of them is very wide.

Dr. Forster himself is to be congratulated upon the continued progress of the Institute during his directorship and the maintenance of the object for which it was established, namely, to promote original investigations and their use for the benefit of India. His services to the cause of higher scientific education and research in India are widely known and highly appreciated. A remarkable testimony to the regard in which he is held at Bangalore, and a tribute of gratitude from the staff and students of the Institute, were afforded by a large and distinguished company which assembled at the Institute on March 14 to express regret at his departure and convey the best wishes to him and Mrs. Forster. Dr. Forster was presented with an address and a silver casket of exquisite workmanship, and Sir Mirza Ismail, Prime Minister of Mysore, who presided, referred in glowing terms to his zeal and devotion to the Institute. In the course of his speech, Sir Mirza said: "Dr. and Mrs. Forster have come to love this State as much as we do. They have identified themselves with us completely. I need not tell them, for I am sure they know it well enough, that their decision to continue to live amongst us, after retirement, is a source of the utmost gratification to their friends and even to those who are not privileged to know them personally. We feel that we shall be enriched by their presence in our midst. . . ." As Dr. Forster is retiring to the beautiful garden city of Mysore, which is only a couple of hours journey from Bangalore, he will be able to continue in touch with the Institute and its activities.

The Institute originated in the munificence and foresight of Mr. Jamsetji Nusserwanji Tata who, about the year 1896, proposed to place in trust Bombay properties with a capital value of Rs. 30 lakhs (£225,000) to endow a research institute for India. During the development of a scheme for implementing this benefaction, the Government of Mysore allocated 371 acres of suitable property about three miles from the outskirts of Bangalore, contributed Rs. 5 lakhs (£37,500) towards the buildings and promised a subsidy of Rs. 50,000 (£3,750) per annum without limit of time; while the Government of India agreed to make an annual grant of Rs. 1·5 lakhs (£11,250).

On the death of Mr. J. N. Tata, his two sons, the late Sir Dorabji and Sir Ruttonji Tata, announced their intention of giving effect to the wishes of Mr. J. N. Tata, and transferred the Bombay properties to the Treasurer of Charitable Endowments. The vesting order having been signed in May 1909, the Council appointed thereunder authorised the construction and equipment of the buildings already planned by Dr. M. W. Travers, who had been appointed director in August, 1906. The first students were admitted to the departments of general chemistry, applied chemistry and electrical technology in July 1911, the department of organic chemistry being opened in September of the same year.

It was hoped by Sir Dorabji Tata that the Institute would become an all-India institution, and this intention is to some extent realised by the students in it being drawn from all parts of the sub-continent, though for geographical reasons those from Mysore and Madras predominate. On the financial side, however, it cannot be said that the support to the Institute is of an all-India character. Excepting Mysore and Hyderabad, which have uniformly and generously supported the Institute, contributions from other States and Provinces have been altogether disproportionate to the benefits received by their students. Bombay has approximately the same number of students in the Institute as Mysore and Madras, yet it contributes nothing to the finances. The absence of support from Bombay and Bengal is much to be regretted, for it means that other regions are influenced by it and neglect to afford the aid

which would make the revenue of the Institute an all-India responsibility.

The following analysis of applications and admissions for the five years 1926–30 shows the geographical distribution, and the considerable excess of applications over admissions from all parts of the country :

	Mysore	Madras	Bombay	Bengal	Rest of India
Applications ..	151	239	244	72	148
Admissions ..	73	88	91	26	51

It was pointed out in an article in *Current Science* of October last that those responsible for developing the resources of the Institute, while placing in the foreground the requirement to impart advanced knowledge, and instruct in the methods of research, have consistently kept in mind any possible bearing which the results may have on the inception of new industries and the improvement of existing ones. Ample evidence of this recurs each year in the appendix to the Council's annual report, showing in abridged form the current subjects of investigation ; but although the technological application of the work at the Institute has been wide, and in several cases valuable, there is doubtless room for expansion in this field.

One example of an economic application latterly engaging the attention of the Institute is the systematic inquiry into the cause of spike-disease in sandal. This has now continued during the past five years in co-operation with the Government of Madras and the Coorg Commission, the results being summarised in periodical reports published separately from the *Journal* of the Institute. The latter publication contains a description of the various inquiries, academic and economic, which have been pursued in the laboratories, and in the past fifteen years has comprised about two hundred issues. The range of subjects is wide, and includes many that might be turned to an industrial utilisation of principles or materials. This aspect of the work is reflected in the fact that the major proportion of the Institute's former students have been absorbed into non-academic occupations, particularly in the field of electrical technology.

An estimate of the factors contributing to the growth of the Institute may properly include the following considerations. The original organisation was planned by Dr. M. W. Travers, who served as director from 1906 until 1914, being succeeded in the following year by Sir Alfred Bourne until 1921. On Dr. Travers leaving India after constituting the chemistry laboratories, Prof. J. J. Sudborough became head of the departments of general and organic chemistry, terminating in 1925 his fourteen years' association with the Institute, and having developed a highly efficient department of organic chemistry dealing principally with indigenous natural products. He was ably followed by Prof. J. L. Simonsen, who remained only two years and is now professor of chemistry in the University College of North Wales, Bangor. In 1916, Prof. H. E. Watson, who had rendered excellent service as assistant professor of general and inorganic chemistry since 1910, was appointed professor and is now head of that department, which he has raised to a very high level. On retirement of the late Prof. Rudolf from the chair of applied chemistry in 1914, the duties of that office were assumed in 1916 by Prof. G. J. Fowler, whose reputation in the field of chemical bacteriology led the Council in 1921 to convert the chair into that of biochemistry : this branch he developed in several directions advantageous to India until 1924, when Prof. R. V. Norris was appointed and remained until 1929, making valuable contributions to its activities. Since August of that year Prof. V. Subrahmanyan has been in charge.

Dr. Alfred Hay (who died in April 1932) was appointed as the first professor of electrical technology in January 1908, retiring at the end of 1922. During his fifteen years' tenure he organised an admirable system of training by which engineering graduates of Indian universities are fitted to assume positions of responsibility as electrical engineers. His successor, Prof. J. K. Catterson-Smith (1923–1930), now professor of electrical engineering at King's College, London, greatly extended the premises and equipment of the department, and established a section of electrical communication engineering designed to meet the rapidly expanding interest in wireless telegraphy and telephony. He also founded the Institute Engineering Society, and a journal entitled *Electrotechnics*. In 1931 he was succeeded by Prof. F. N. Mowdawalla.

The *Journal of the Indian Institute of Science* describes the research work issuing from the laboratories, and embraces about two hundred original communications. A preliminary account of these is usually presented at the Indian Science Congress, which has received warm support from the Council by deputations of many students and members of the teaching staff to attend the annual meetings.

An important auxiliary to the work of the departments is the Library, which has been maintained in a state of increasing efficiency by Mr. K. Amrita Row. The library contains 21,000 volumes, principally research journals, and is the best of its kind in India. Research students at Bangalore have thus available for reference the published results of investigations carried on almost anywhere in the world. It is easy to understand, however, that notwithstanding the facilities which the Institute affords for advanced study and research, many students in universities in other parts of India hesitate to undertake post-graduate training there. Even if such an Institute were established in Great Britain, where the distances are not of the same continental order, it may be doubted if it would attract so many science graduates taking courses of advanced study and training for research as are now at Bangalore. Since the Institute was founded there has been

a notable increase in the amount of research work carried on in many of the Indian universities, and there is a natural tendency for each such institution to retain its most promising research students instead of letting them go elsewhere.

This and other difficulties in the way of expansion were surveyed by a committee of inquiry, of which Sir William Pope was chairman, appointed in 1921, and helpful suggestions for overcoming them were made in the report of the committee published in the following year. Dr. Forster was appointed director of the Institute shortly after the publication of the report, as a scientific man of eminence with proved administrative capacity, and he has in every way justified his appointment. The committee contemplated the institution of a department of physics as a link between existing activities in physical chemistry and electrical technology, but sufficient financial support has not been afforded to carry out this recommendation. It may be hoped that the new director, Sir Venkata Raman, will by his enthusiasm and untiring energy be able to increase the financial resources sufficiently to establish a new department of physics on a scale worthy of the Institute and of the high expectations of its founder.

Trevithick Centenary Commemorations

DURING the past week, many tributes have been paid to the memory of Trevithick, the great Cornish inventor and engineer. On April 24 Prof. C. E. Inglis delivered the memorial lecture, at the invitation of the Trevithick Centenary Commemoration Committee, in the theatre of the Institution of Civil Engineers, by kind permission of the council. Sir Murdoch MacDonald, the president of the Institution and the chairman of the Committee, was in the chair.

In beginning his lecture, which is being published in full, with illustrations, in this week's *Engineer*, Prof. Inglis said that when Trevithick died on April 22, 1833, no obituary notices proclaimed that the nation had lost a mechanical genius of the first order of magnitude, and his memory passed into an oblivion which for many years was almost complete. But the greatness of the man, and the impetus he had given to engineering science, was such that his fame could not suffer permanent eclipse. Slowly, but with an ever-increasing luminosity, his genius shone forth, and with the passage of time he seems to rise higher and yet higher above his contemporaries.

Fifty years ago, the name of Richard Trevithick had won an honoured position throughout the engineering world, and now posterity, more discerning than his own generation, deems him not unworthy to be enthroned alongside and on the same exalted plane with his predecessor and one-time rival, the illustrious James Watt.

Trevithick was born at the foot of Carn Brea in the parish of Illogan not far from Camborne on April 13, 1771. Up to about the age of twenty-six years, he was connected with Cornish mining engineering and was familiar with all sides of engineering practice. A man of fine physique, forceful, energetic, self-confident, decisive and independent, he was yet of a kindly, generous disposition and though when goaded by opposition he would flare out, he cherished no animosities and there was a singular absence of anything approaching meanness in his character. The overwhelming vitality and driving force of the man, said Prof. Inglis, is strikingly portrayed in the bronze statue erected in Camborne last year.

Trevithick's great work began with his experiments with steam-driven locomotive models in 1797, and from then until in 1816 he left England for the Peruvian mines, was the period when his constructive genius flared forth with a brilliance which was almost continuous. To those years belonged his construction of the Camborne steam road carriage of 1801, his great patent of 1802 for stationary and locomotive high-pressure engines, his London steam road carriage of 1803, his historic rail locomotive, which he built at Penydarren in South Wales in 1804, his London rail locomotive of 1808, his application of steam engines to pumping, winding, dredging and agriculture, his invention of the Cornish boiler, his attempt to drive a tunnel beneath the Thames between Rotherhithe and Limehouse, and his patents for iron ships, iron docks and iron tanks. During the years 1797–1816 he was, in Prof. Inglis's words, "a veritable volcano of inventions". Some of these, because they ante-dated engineering progress by many years, failed to come to fruition, but others, notably the high-pressure semi-portable steam engine, gave an impetus to mechanical science which gathered momentum with the passage of time, and for which his successors mainly reaped the honour and financial reward.

One of Trevithick's inventions of this time was the water-pressure pumping engine, and speaking of a large engine of this type erected in Derbyshire, Prof. Inglis remarked : "This simple and powerful type of engine was verily the mechanical embodiment of its creator's mental and physical characteristics, and Trevithick's creations invariably inherited his own personal attributes—strength and exuberance of energy almost amounting to rashness." In comparison with Trevithick, Watt was a timorous spirit ; steam in his mental vision was merely an agent for forming a vacuum, and the potentialities of danger he envisaged from the use of high-pressure steam outweighed any possible advantages which could be gained thereby. Trevithick, on the other hand, never counted that particular cost ; he never permitted potentialities of danger to obscure his horizon, and it was this entire absence of fear which, perhaps more than

any other mental characteristic, impelled him forward to win imperishable renown as the originator of the high-pressure engine.

Prof. Inglis's study was naturally based on the record of Trevithick as given in the biography published by his son Francis in 1872, and unfortunately he was not able to throw much new light on the actual construction of the engines through which Trevithick is known as the 'father of the locomotive', but his lecture contained many notable passages concerning the man himself.

The actual centenary celebrations began on Saturday afternoon, April 22, at Camborne by a demonstration. This was followed on Sunday forenoon by memorial services in Tregajorran Methodist Chapel, which stands on the site of Trevithick's birthplace, and in Dartford Parish Church, in which is a bronze tablet recording Trevithick's burial in the churchyard of St. Edmund, King and Martyr. Reference was also made to the centenary at evensong in Westminster Abbey by the Archdeacon of Westminster, the Ven. V. F. Storr, and after this service, the Memorial Committee placed a wreath beneath the Trevithick memorial window in the north aisle.

The service at Dartford Parish Church was attended by many members of the Urban District Council, representatives of many local associations and engineering societies and by the staff and employees of Messrs. J. and E. Hall, Ltd., in whose works Trevithick's last days were spent. The service was conducted by the vicar, the Rev. E. Mitchell, the sermon was preached by the Right Rev. the Lord Bishop of Rochester, and after the service an address was given by Mr. L. St. L. Pendred and wreaths were placed on the memorial tablet.

In concluding an address of singular eloquence, Mr. Pendred said: "I could speak to you of Trevithick's inventions; of his locomotives, his steam boats, his pumps, his boilers, his tunnel under the Thames. But what would it avail? You may read of these things if you will. They are now of no account. The tide of invention has swept over them. Precious and dear to the memory, but all sunken; not reclaimable, not useful any more:

> 'Wedges of gold, great anchors, heaps of pearls,
> Inestimable stones, unvalued jewels,
> All scattered in the bottom of the sea.'

"No inventor will turn to them for inspiration. Dead things. Drowned things. Swept over by the vast flood of invention which broke all barriers soon after Trevithick had gone to rest, and still sweeps onwards. You may see them in the Museum now. Toys; antiques; quaint relics. Valueless things . . . And yet, not valueless if they bring back the gift of Wonder to an age that has ceased to be surprised at anything. And if we can only wonder, we shall pay the greatest tribute of our praise to Trevithick. We shall wonder how a man with so little knowledge, so few opportunities of learning, such poor means of achieving, yet wrought from his brain things that no one else could think of, could *make*. It is not enough to think, one must *do* too. There are always some who will rob every inventor of his honour by proving that others had thought of the same thing before him. Thinking is not enough; it is the men who hammer their thoughts into realities that matter to the world. That was the way of Trevithick, the Cornishman; that is why we honour his name to-day."

Obituary

Prof. J. Millar Thomson, F.R.S.

JOHN MILLAR THOMSON was born in 1849 in the precincts of the old college of Glasgow, where his father, Prof. Allen Thomson, was professor of anatomy. John Millar Thomson's family has had a long connexion with the University of Glasgow, dating from 1761, at which time his great-grandfather, John Millar, was professor of law. Other members of the family afterwards held chairs in mathematics, philosophy, medicine and anatomy, pathology and military surgery in one or other of the Scottish universities.

John Millar Thomson was an only child and was brought up in very close companionship with his father, with the result that he was from early boyhood constantly in contact with notable people in academic circles, especially as his father was one of fourteen professors all living in the old college. As a boy of thirteen years of age he travelled with his father in France and Germany, visiting a number of his father's friends. They remained for some time in Würzburg with Allen Thomson's great friend, Kölliker.

During the time when Prof. Allen Thomson was going into the plans of laboratories and lecture-rooms in the new University buildings at Glasgow, John Millar Thomson accompanied his father on several occasions where, as a boy, he could be helpful in such simple ways as 'holding the tape' and in taking down notes. This started an interest in architectural matters which he retained all his life. In discussing laboratories with him when he was at King's College, I have lively recollections of his sitting down to make plans, and of his saying, as he brought his scales and ivory rule out of his pocket, "These are the very ones with which my old father drew out his plans when I was a boy". His skill as an architect was such that when he drew out plans for a house for one of his cousins, these were accepted by the builders as complete, and were worked to by them.

Educated at the High School and the University of Glasgow, Millar Thomson entered the faculty of medicine after having first taken the usual curriculum in arts. He soon came to the conclusion, however, that he did not wish to continue

a medical training. On the advice of Prof. Thomas Anderson and Prof. Lyon Playfair, he took up the study of chemistry. Naturally, from his early associations with so many professors, his ambition was to enter academic life. He worked as a student in Prof. Anderson's laboratory from 1866 until 1871, being appointed assistant to Prof. Anderson in 1869. In 1868 he came to London to see Prof. W. A. Miller and Prof. C. L. Bloxam with regard to a demonstratorship in chemistry at King's College, London, vacant owing to the transference of his friend J. T. Bottomley to the Physical Department of King's College. I remember his telling me about that interview and saying that, after it, he came to the conclusion that he was too young for the post. He returned, therefore, to Glasgow until, on the death of Prof. Miller in 1870, Prof. Bloxam, who succeeded to the chair of chemistry in King's College, sent for him and offered him a position of assistant demonstrator, which he took up early in 1871. Walter N. Hartley at the same time was appointed senior demonstrator. At that time the assistant demonstrator did not lecture, but Hartley became seriously ill shortly after his appointment, and John Millar Thomson took over the whole of the senior demonstrator's work in both the day and evening-class departments. Bloxam told me, in later years, of the great success of John Millar Thomson's lectures and of his organisation of the practical classes given into his charge.

In 1879, Hartley was appointed professor at the College of Science, Dublin, and Millar Thomson became senior demonstrator in his place. I attended his lectures in that year, and I can recall now the ease with which they could be followed, the clearness of his exposition, and the wealth of experiment with which the lectures were illustrated. His lectures were always interesting and often experiments difficult to carry out were shown by him with brilliant success, but he never allowed applause in College lectures. One other thing I can recall very clearly, namely, there was no chance of being visibly inattentive ; still less was there any opening for levity or other form of disturbance. This was a tribute not only to his power of holding an audience, but also to his personality : one felt that 'fooling' was quite out of place. But strict and dignified as he was in the work of the College, both then and throughout his career he gained, in addition to the high respect of his students, their lasting affection.

From 1880 until 1887, in addition to his work at King's College, Millar Thomson gave lectures in chemistry at Queen's College, Harley Street, and was given the title of professor of chemistry in that College. It was during this time, and before he took the responsibility of the headship of the Chemical Department at King's College, that he carried out his investigations in connexion with crystallisation and supersaturated solutions, and also on a number of other subjects, for example, the composition and properties of building stones, in continuation of some work which he had done under Prof. Anderson at Glasgow.

Although he was much occupied with his own teaching and experimental work, he was a man with such strong general sympathies that he could not avoid being pressed to take an active and guiding part in practically all the College functions and functions organised by the students' societies. The Dramatic Society in particular owed much to him. He possessed remarkable dramatic talents and was truly a fine actor. This did not appear in his lectures, either at the College or at the many public lectures which he gave ; into these he threw all his earnestness. It did, however, give him a singular power of expressing the wishes and desires of others when welcoming a new colleague, bidding good-bye to a retiring colleague, or speaking at functions such as College dinners or public dinners. I always felt, when John Millar Thomson spoke on such occasions, that in virtue of his personality, his manner, and his simple but effective elocution, he set the tone of the whole function on a high level. It was typical of him to say the right thing whenever he was called upon to speak, even at a moment's notice.

I must not omit some reference to his activities in photography, in which he had a life-long interest ; for some time in his earlier days he taught the principles and practice of photography to the engineering students of the College.

The individual character and ability which he had shown, and the influence which he had exerted in promoting the highest interests of the College in these earlier posts, were emphasised when Millar Thomson became head of the Chemical Department at King's College. It was natural, therefore, that when the post of vice-principal became vacant in 1905 on the resignation of Prof. W. Grylls Adams, it was the unanimous desire of his colleagues that John Millar Thomson should be invited to take over the additional duties of vice-principal. He accepted, and represented the College on many important occasions. I have often heard from those who were present on such occasions how impressed they were with the charm, power and highmindedness of the man.

In notices of him in other places, his public work in connexion with the Chemical Society, the Institute of Chemistry and the University of London, has been described. I have endeavoured here to give some impression of the man himself. My opportunities for knowing him intimately were many, for I saw a very great deal of him not only in College but also in his private life.

I should not like to conclude without recalling Mrs. John Millar Thomson, the youngest daughter of Dr. Charles Arthur Aikin, a grand-niece of Miss Lucy Aikin, and a grand-niece of Mr. Arthur Aikin (who was secretary of the Royal Society of Arts from 1817 until 1839) : she was also a great grand-niece of Mrs. Barbauld. I have often heard John Millar Thomson say how much he owed to the sympathy and ability of his wife. I myself was frequently present in their home, and when

we were discussing College matters or the subject of a lecture, he would often turn to her for criticism and suggestions connected with decisions which he had made, and always with benefit.

John Millar Thomson was a remarkable man, of great ability, earnestness of purpose, and commanding influence, combined with a fine sense of humour and a great power of sympathy. He would have been a smaller man if he had realised how great a personality he really was.

Herbert Jackson.

The death is announced of Mr. Walter E. Roth, which took place on April 5 after an operation at Demerara. Mr. Roth was a brother of the late Mr. H. Ling Roth, curator of the Bankfield Museum, Halifax. For many years before proceeding to British Guiana, Mr. Roth was Protector of Aborigines, Queensland, Australia. He was the author of "Ethnological Studies among the North-West Central Queensland Aborigines" (1897) and of a number of monographs on various aspects of the culture of the Queensland aborigines which appeared as official bulletins. He also wrote a number of papers, mostly technological, on the culture of the Indians of British Guiana which appeared in the *Journal of the Royal Anthropological Institute*, the reports of the Bureau of American Ethnology and elsewhere.

News and Views

Jews in Germany

The political significance of Nazi revolutionary supremacy under Herr Hitler in Germany is outside our field; but the treatment of the Jewish learned and professional classes stands condemned in the eyes of the intellectual world. It is a relapse to the crass repression of the Germany of Heine's day and the *Judenhetze* of Prussia fifty years ago. An outstanding case is the resignation by Prof. James Franck, Nobel prizeman with G. Hertz for physics in 1925, of his chair in experimental physics in the University of Göttingen. Prof. Franck, it is said, probably would have been spared the forced retirement now operative against Jewish officials, including university professors; but he feels that Germans of Jewish descent are being treated as foreigners and foes of the Fatherland, and asks to be released from his office. Prof. Franck served with distinction during the War and received the Iron Cross of the First Class. His action follows fittingly on the retirement of Prof. A. Einstein from Germany, and is the logical, indeed the only, reply for a man of his standing to the acts by which Jews are being excluded from the liberal professions and debarred from the universities. This is the achievement of a movement which, ever since the War, has sought to mould the German people to one pan-Teutonic pattern—in accord with neither the facts nor the conclusions of ethnology. In the denial of a part in Germanic culture to any element alleged to be foreign, Jews, liberals and socialists are to be treated alike; but Jews have suffered most.

The Jewish people need no one to hold a brief on their behalf. The contribution of the Jews to the growth of civilisation in the Western world speaks for itself. There were Jews in Germany in Roman times, and wherever they were found in medieval Europe, in spite of, or perhaps because of, their disabilities, they were laying the foundations upon which the modern system of finance and commerce was built up. In Italy as bankers, they rivalled the great houses of Lombardy. In the liberal arts, the preservation of much of classical literature and philosophy was due to them. In the later Middle Ages they were largely responsible for the reputation of Spain as a centre of intellectual and scientific development. In the middle of the eighteenth century the revival of Jewish learning, which had Mendelssohn for its inspiration and leader, paved the way for the Jewish people to take its place in the intellectual life of the respective countries of their adoption as their disabilities were gradually removed, so that Bunsen could say that, in the German universities of his day, the greater number of the principal professors were Jews. Everywhere the Jews have won to pre-eminence in literature, in the arts, especially music, and the drama. Even if it were not admitted that the Jews had contributed to Germanic culture—a contention which could not be accepted without argument—in the world of learning and science it is to men such as Oppert, the classical scholar, Benfey, the Orientalist, and Heinrich Hertz, the physicist, to take three names only, selected almost at random, that she owes her international standing, just as much as to any of her sons of purest German stock.

William Morgan, F.R.S., 1750–1833

William Morgan, who died on May 2, 1833, was the son of a doctor at Bridgend and studied medicine in London, but he failed to make headway after his father's death. He returned to London, where his uncle, Richard Price, found him work with the first life assurance company to grant assurances for the whole of life at a level premium depending on the age when the assurance was effected. This new venture gave Morgan his opportunity. He studied mathematics, applied them to life contingencies and produced, in 1779, his "Doctrine of Annuities and Assurances". He followed this with a series of five papers to the Royal Society in which, for the first time, solutions were given of complicated survivorship probabilities in terms that enabled a computer to use actual mortality statistics instead of an arbitrary law of mortality such as de Moivre's. He was given the Copley Medal in 1789 and his fellowship of the Royal Society in the following year. Morgan did still more important scientific work in connexion with his business, where he worked out the proper reserves that should be kept by a life assurance company and studied

the difficult problems of surplus and bonus distribution so skilfully that he evolved a fair method for the particular scale of premium—the general problem still gives difficulty and is widely discussed even now. Morgan also studied the mortality experience of the persons insured, and his manuscript volume on the subject, from which he gave abridged tables in his published work, was the first investigation of the kind. Morgan published some tracts on public finance, wrote a life of Price and edited his works, contributed articles to Rees' "Cyclopedia", etc., and, in earlier days, displayed an interest in electricity and heat. His great achievement was that, in effect, he started the profession of 'actuary' and a new science which would nowadays be called actuarial science, and he proved that life assurance was a practical possibility and not merely an interesting theory.

Dr. William Babington, F.R.S., 1756-1833

ON April 30 occurs the centenary of the death of Dr. William Babington, one of the founders of the Geological Society of London, who during his life gained the respect and admiration of all with whom he had come in contact, both by his skill as a physician and by the elevation of his character. Born in Ireland in 1756, at the age of twenty-one he became an assistant surgeon at the Haslar Naval Hospital, and four years later was appointed apothecary to Guy's Hospital, London, of which for some years he was also the physician. Though he made no notable contribution to science, he wrote several acceptable works on chemistry and mineralogy and it was at his house that in 1807 the gathering took place which led to the formation of the Geological Society, the first president of which was that "staunch geological Tory" George Bellas Greenough. Babington himself served as president in 1822 of the Society he had assisted to found. He was also one of the founders of the Hunterian Society. Described by Geikie as "a kindly, bland and courteous veteran", one of his last public actions before he fell a victim to an epidemic of influenza was to preside over the Priestley centenary celebrations. It was said that history does not recall a physician more loved and respected than Babington, and it was this wide-spread admiration for his character which led to the erection of his statue in St. Paul's Cathedral. The statue is a noble piece of work by Behnes. At his death, Babington was buried in St. Mary Aldermanbury in the City. He left several children and one of his daughters became the wife of Dr. Richard Bright, the discoverer of 'Bright's disease'.

Eradication of Prickly Pear in Australia

STRIKING success continues to attend the efforts to eradicate prickly pear (*Opuntia* spp.) in Queensland and northern New South Wales, mainly through the introduction of *Cactoblastis cactorum*. By the end of 1930, some 3,000,000,000 eggs had been distributed throughout the length and breadth of the sixty million acres infested and by the end of 1931 the insect existed on practically every acre. To-day probably 80 per cent of the dense primary pear in Queensland has been destroyed, while in New South Wales the figure is 50–60 per cent if one excludes the Hunter Valley and Camden districts where climatic and soil factors are delaying, but not preventing, the progress of *Cactoblastis*. Queensland is energetically pushing a scheme of development of reclaimed land and already 1,515,000 acres have been re-selected for mixed farming purposes and 1,701,000 for grazing. Unfortunately, the sight of miles of dead and rotting cactus tends to create the impression in political circles that the problem is solved and that further expenditure upon intensive research work is not needed.

SUCH views are dangerous and quite unjustified. Re-growth, owing to incomplete destruction of butts and roots, is a problem which grows in seriousness as the old pear, supporting an insect population ready to attack new shoots, disappears. It will be unwise to leave the control of re-growth to *Cactoblastis* alone. Also parasitism, though not yet causing more than 20 per cent loss in any district, and much less in some, requires close watching: and the Hunter Valley area of two to three million acres presents a unique problem in some respects, though *Cactoblastis* is more promising there to-day than it was eighteen months ago. Moreover, though the infestation is almost entirely the vulnerable *O. inermis* and *O. stricta*, it would be unwise to ignore the menace of the tiger-pear (*O. aurautiaca*) now covering some 25,000 acres, and the tree pears (*O. tomentosa* and *O. streptacantha*). *Cactoblastis* destroys the upper growth but not the underground bulb of the former, the recuperative powers of which are very great; while it destroys only the young plants of *O. tomentosa*. Other enemies of these must be sought and entomologists have already been sent to South America to seek parasites of them and allied species.

A Complex Solar Halo

A VERY well-developed solar halo of 22° radius with mock sun ring was observed from places in Kent and Sussex on April 14. An excellent description has been received from Mr. R. C. T. Evans and his son, Dr. C. Evans, 10 Eddington Lane, Herne Bay. The 22° halo was observed at about 12.35 p.m. (B.S.T.), and two "bright patches" proceeding not quite radially from the eastern and western sides, at angular positions corresponding roughly with those of the hour hand of a watch at 9.30 and 2.30 o'clock. Shortly afterwards, these bright patches were observed to form part of a luminous ring which reached northwards to about the position of the pole star (invisible, of course, at the time) but did not cross the region inside the 22° halo. The elevation of the sun must have been nearly 48° at this time and that of the pole star only very slightly greater in this latitude; there seems, therefore, every reason for believing that this ring, which was faint except near the 22° halo, was the mock sun ring, which has the zenith for its centre. The 22° halo showed strong red coloration on the edge nearest to the sun, and a suspicion of blue towards the

outside—usual features when this halo is strongly developed. There are two points of particular interest about this display. The haloes were seen from near the centre of a large anticyclone, whereas well-developed haloes are more often seen near the outer margin of a depression or even well within the cyclonic vortex. Further, the description from Herne Bay states that the bright patches near the 22° halo, which formed part of the mock sun ring, showed some red colour at the ends nearest to the sun, which is unusual, and they appeared to lie between the observer and one of several flocculent clouds present in the sky which passed across the eastern bright patch. Optical theory suggests that all parts of the haloes were due to a much more elevated veil of cirriform cloud which, on this occasion, was only dense enough to make the blue of the sky appear pale, and that the flocculent clouds should have lain in front of the haloes.

New Ascent into Stratosphere

SOVIET men of science are planning an ascent into the stratosphere in July. The ascent will be made in a balloon which is being specially built for the purpose under the supervision of the Leningrad Section of Osoaviakhim (Society for Air and Chemical Defence). Attached to the balloon will be a large, hermetically sealed gondola in which the investigators will be seated. They will wear special clothing and will be equipped with parachutes in case a forced landing is necessary. A meeting of the committee which is arranging the flight has recently been held in Leningrad. It is proposed to make the ascent from the central part of European Russia. The exact point has not yet been decided upon. A trial 12 km. flight into the stratosphere will first be made in order to accustom the investigators to the experimental conditions. The engineer in charge of construction of the balloon, Mr. Chertovsky, and Mr. Vasenko, its designer, are to make the trial flight. In July it is planned to penetrate to a height of 22 km. Among those making the ascent will be Prof. Rynin, a well-known authority on aeronautics, and, health permitting, M. Joffe, an eminent Soviet physicist and member of the Soviet Academy of Sciences.

The Great Siberian Meteorite

A SPECIAL meteorite commission has been appointed by the Soviet Academy of Sciences to investigate the traces of the large meteorite which fell in the Enisseisk district of Siberia on June 30, 1908. The commission is making preparations to set out on an expedition to the Tungus swamps some time this summer under the leadership of the Soviet meteorologist, Mr. Leonid Kulik. This is the fourth expedition that has been led by Mr. Kulik to search for traces of the Tungus meteorite. The expedition sent out in 1927 discovered in the place where the meteorite fell uprooted trees over a radius of scores of kilometres, their tops towards the centre. Trees blown down by the wind were lying over an area of fifty kilometres from the falling place of the meteor, and the whole locality over a radius of twenty kilometres from the centre was scorched by the high temperature produced. The expedition of 1929 carefully examined the northern section of the central area of the wind-felled wood and made some excavations in the centre. The exploration of the southern part of this wood confirmed the belief that the meteorite had fallen in that spot. The first three expeditions led to the discovery of immense areas of wind-felled trees and traces of burning, but no specimens of the meteorite were found. The aim of the new expedition is to find the exact place of the submerged crater and if possible to obtain specimens of the meteorite itself. In April 1930 Dr. F. J. W. Whipple read a paper on the meteorite and its effects before the Royal Meteorological Society under the title "The Great Siberian Meteor and the Waves, Seismic and Aerial, which it Produced" (*Quar. J. Met. Soc.*, vol. 56, July 1930).

Research and the Linen Industry

IN presenting the report at the thirteenth annual general meeting of the Linen Research Association on December 12, 1932, Mr. H. L. McCready, chairman of Council, referred to the importance of research in promoting the welfare of the linen trade and the restoration of prosperity. Due mainly to a reduction of £1,000 in each of the grants from the Empire Marketing Board for flax and fibre production work and from the Department of Scientific and Industrial Research, there was an excess of £2,837 of expenditure over income, £1,444 of this being represented by reserves for rent and depreciation. In spite of drastic economy, however, it was possible to develop during the year what appears to be a much improved and more economical method of treating flax. An entirely new system of handling the material was evolved, existing machinery was improved, new machines designed and constructed, and a superior article of good colour, straight, parallel and clean was produced. Useful work was carried out on various aspects of the bleaching and dyeing of both yarn and cloth. A good deal was discovered about the effect of various reagents on the strength of the fibre. The increased use of coloured effects for borders and checks caused attention to be given to the dyes used and information of the utmost importance regarding various dyes was obtained. The director of research, Dr. W. H. Gibson, underlined the emphasis which Mr. McCready laid on the service aspects of research. There has been a strong tendency for the research work at every stage of the industry to be influenced by questions relating to the raw material on one hand or the requirements of the consumer on the other. The research worker has to take a comprehensive rather than a sectional view of the industry, and research is increasingly demonstrating its ability to give the consumer better service and better value, particularly in relation to the durability of fabrics in washing.

Essential News

FOR those persons who are interested in the world situation but have not the time or the opportunity

to gather the necessary information and facts for themselves, *Essential News*, which is a weekly non-party bulletin, should serve a useful purpose. It is composed of quotations from various papers or periodicals and summaries of significant facts, together with constructive suggestions drawn from English and foreign sources. Thus, in a recent number special attention is devoted to economic reconstruction in Europe. There is a description of Delaisi's Five Year Plan for Europe, which advocates the planning of large schemes of work to reduce unemployment in Europe. The plan envisages the construction of great roads running north and south connecting the Baltic, Poland, the Danubian countries and the Mediterranean. This would open up an immense area in which some sixty million peasants are still living a primitive economic life. Another article in the same issue also bears on the construction of international roads; this is an extract from a pamphlet by Mr. J. E. Meade entitled "Public Works in their International Aspect". According to Mr. Meade, roads are cheaper to build than railways. The nineteenth century provided capital for railways; could not, he asks, the twentieth provide it for special motor roads? A European network of roads, roughly 9,000 miles in extent, financed by a European petrol tax of approximately one penny per gallon, built over a period of five years, would provide work for 188,000 workers in the first year, rising to three quarters of a million in the fifth year. The cost would be about 170 million pounds (gold). Some such roads already exist, in particular between Cologne and Bonn, between Milan and Turin, Como and Brescia, and one is being built between Rome and Naples.

George Edwards's Picture of the Dodo

THE biographical notice of George Edwards, the eighteenth century naturalist, which appeared in the January issue of *Science Progress*, may be amplified by some points of interest in regard to Edwards's picture of the dodo (*Didus ineptus*). Edwards, himself, tells us in the "Gleanings of Natural History", Part 2, 1760, that the coloured figure of the bird (Plate 294), was copied in 1757, as reduced, from a picture in oil-colours, of its natural size, this about thirty inches high. Further, that the original was drawn in Holland from the living bird from St. Maurice's Island (Mauritius) in the East Indies; that it was the property of Sir Hans Sloane, at the time of his death, becoming afterwards Edwards's property. The owner deposited (1759) the picture in the British Museum "as a great curiosity", and with Sloane's record. The original canvas, it may be mentioned, portrayed various other birds; also a few lizards and a toad. Edwards, however, simply selected the dodo for his plate, adding a guinea-pig for the sake of relative magnitude. It appears that the picture was copied in brighter colours (it was blackened through age) about 1877 by Mrs. L. Gunther, mother of Dr. Albert Günther, keeper of the Zoological Department of the British Museum. From this copy, which is at Oxford, a postcard in colour was ultimately made, and is obtainable at the Old Ashmolean, Oxford. The large picture which hangs in the Bird Gallery of the Natural History Museum, South Kensington, is the original canvas, which has been cleaned; the postcards in colour available at the Museum are reproductions of this picture.

Physical Bibliographies

THE recent issue of the index numbers of the physics and the electrical engineering volumes of *Science Abstracts* completes these volumes for the year 1932. The physics volume deals with 5,364 abstracts in 1,316 pages and the electrical engineering one with 2,926 in 756 pages. While the latter is slightly larger than the 1931 volume and author and subject indexes are on the same lines as in previous years, the former is about twenty per cent larger and its subject index has been greatly improved and its length increased about twenty-eight per cent to 197 pages. Physics papers are divided into eight main classes, each class into sections, with key-headings, and each section into sub-groups with sub-headings. For example, a main class—general physics—has twenty-one key-headings, one of which is elasticity and plasticity. This has ten sub-headings, two of which are photoelasticity and vibrations, with cross references to acoustics, piezoelectricity, seismology and thermodynamics. The key-headings are arranged in alphabetical order throughout the index. These improvements will be welcomed by users of the volume. The *Revue Bibliographique* of the *Journal de Physique* for 1932 is not yet completed but the volume for 1931 devoted approximately 130 pages to the subject index, 160 to author index and 850 to abstracts. In the subject index the whole of the sections under a class appear together and are divided into sub-sections or groups.

Veterinary Publications

WITH the January number (vol. 3, No. 1) the *Veterinary Bulletin* enters upon the third annual volume. A regular monthly issue, begun with vol. 2, will be continued, and by some adjustment of the lay-out of the pages more space will be available for a larger number of abstracts. In this first number, a list is given of the publications from which abstracts will be selected. The *Veterinary Bulletin* is published by the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, the annual subscription being £2. The Imperial Bureau of Animal Health also proposes to issue, should adequate support be forthcoming, under the title *Index Veterinarius*, a complete index to publications relating to veterinary research, administration, etc. An annual volume in crown quarto size would run to about 1,600 pages and a number, consisting of about 400 pages, would be issued each quarter. The *Index* would be prepared on a Gestetner duplicator: the sheets printed on one side only, clear to read, and adequately glued, stitched, and bound. About 10,000 references would be indexed each year, with cross-indexing. The price would be £4 the annual volume, including postage.

Horticultural Education Association Year Book

It is with great pleasure that we notice the appearance of a Year Book of the Horticultural Education Association for 1932 (South-Eastern Agricultural College, Wye. 3*s*. 6*d*. post free). This volume, which we hope is the first of a long series, contains many items of importance to members of the Association, but also has several articles of general horticultural importance. Horticultural activities in various counties are described by the respective county agents or supervisors. Other articles refer to spray spreaders, vegetable breeding, glasshouse research, vegetable diseases, insecticides and fruit storage problems. The Association and particularly the editor, Mr. R. T. Pearl, are to be congratulated upon the production of a very useful volume at a reasonable price.

Marmite

We have received from the Marmite Food Extract Co., Ltd., London, E.C.3, a booklet describing the medicinal and dietetic value of 'Marmite'. This is an extract of yeast, rich in vitamins B_1 and B_2. Vitamin B helps maintain the appetite and proper function of the digestive tract, and also aids growth, reproduction, and lactation. The reserves in the body are very small, so that a regular daily intake is required. Recent work has shown that 'Marmite' is of value in the treatment of the pernicious anæmia of pregnancy, in the anæmia of sprue and cœliac disease and possibly also in true Addisonian pernicious anæmia : all these anæmias belong to the megalocytic group. Strauss and Castle believe that normal hæmatopoiesis depends upon the interaction of two factors, an intrinsic one present in normal gastric juice, and an extrinsic one occurring in certain foodstuffs, which is abundant in 'Marmite' and may be identical with vitamin B_2. Up to 4 ounces of 'Marmite' may be taken daily by an adult.

Dorothy Temple Cross Research Fellowships in Tuberculosis

The Dorothy Temple Cross research fellowships in tuberculosis for the academic year 1933–1934 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1. The object of these fellowships is to give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". Candidates must be British subjects and must possess suitable medical, veterinary or scientific qualifications. The fellowships will preferably be awarded for projected studies or inquiries outside Great Britain. They will be awarded for one year as a rule, and are of the annual value of not less than £350. It may also be possible to award a senior fellowship of considerably greater value for an intensive study of some particular problem of tuberculosis at a chosen centre in another country. Further particulars are obtainable from the Secretary, Medical Research Council, 38, Old Queen Street, Westminster, S.W.1.

Announcements

The Daniel-Pidgeon fund for 1933 of the Geological Society of London has been awarded to Mr. J. D. Solomon, who proposes to undertake the correlation of the Pleistocene deposits of south-eastern England with those of neighbouring parts of the Continent.

Senatore Prince Ginori Conti will read a paper on "The Natural Springs of Tuscany and their Industrial Application" before the Royal Society of Arts, Adelphi, London, on May 3, at 8 p.m. The historical development of the venture and its condition at the present day will be described, and illustrated by a film. The natural steam power developments, with special reference to boracic acid production, at Larderello, Tuscany, were described in an article in Nature of January 14, 1928.

The annual meeting of the members of the Royal Institution for the election of officers and to receive the annual report of the Visitors for the year 1932, will be held on May 1. At the conclusion of the annual meeting a portrait of Sir William Bragg, painted by Mr. William Nicholson, will be presented to the Royal Institution.

The Ministry of Health has issued revised port sanitary regulations (Statutory Rules and Orders, 1933, No. 38) which will come into operation on May 1, together with an explanatory circular (1296). These regulations will replace several regulations of 1907, 1920, and 1929. The aim is to consolidate most of the regulations relating to the control of shipping in ports, and to bring quarantine procedure into line with modern methods of international interchange of information relating to epidemic diseases.

Applications are invited for the following appointments, on or before the dates mentioned :—An assistant borough electrical engineer for the Fulham Borough Council—The Town Clerk, Town Hall, Fulham, S.W.6 (May 8). A professor of mathematics and natural philosophy at the McCrea Magee College, Londonderry—The Secretary of the Faculty (May 10). A headmaster of the Ashton-under-Lyne Junior Technical School—G. W. Handforth, Education Office, 8, Warrington Street, Ashton-under-Lyne (May 13). An independent lecturer in mathematical physics at the Queen's University of Belfast—The Secretary (June 12). A woman teacher of science, agricultural science, gardening, geography, and hygiene at the Shortwood Training College for Women Elementary Teachers, Constant Spring, P.O., Jamaica—The Secretary, Cross Roads P.O., Jamaica. A mechanical draughtsman for the Sudan Railways —The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. Mechanical engineers in the Royal Army Ordnance Corps—The Under-Secretary of State (A.G.9), The War Office, S.W.1.

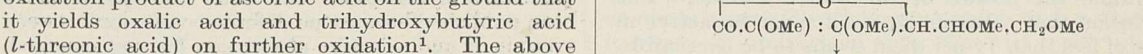
Erratum. In Nature of April 22, p. 565, col. 2, lines 15 and 16, for phrase "one asymmetric carbon atom" read "no asymmetric carbon atom".

Letters to the Editor

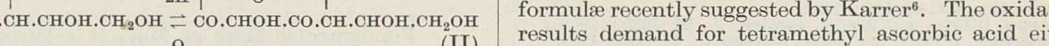
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Constitution of Ascorbic Acid

WE have now confirmed the accuracy of the structure (I) COOH.CO.CO.CHOH.CHOH.CH_2OH which we had previously assigned to the first (reversible) oxidation product of ascorbic acid on the ground that it yields oxalic acid and trihydroxybutyric acid (*l*-threonic acid) on further oxidation[1]. The above formulation represents an open chain acid, but it is now evident that at the moment of formation the substance behaves as a lactone of (I) and not as the free acid. We have already advanced a constitutional formula for ascorbic acid (represented by (II) and its tautomerides) which shows the relationship between (I) and (II) to be as follows:[2]

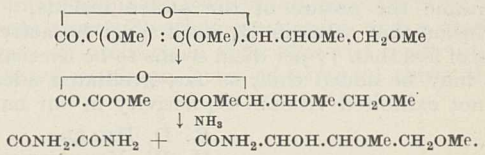


Strong evidence in favour of these views has been obtained from a study of the properties of the methylated derivatives of ascorbic acid. We find that dimethyl ascorbic acid (III), obtained by the action of diazomethane on ascorbic acid, is a neutral substance which reacts with one equivalent of warm $N/10$ alkali without elimination of methyl alcohol. The formation of the sodium salt appears to involve the opening up of the lactone ring in (III). Both methoxy groups are therefore enolic in character (contrast Karrer[3] and Micheel and Kraft[4]). Profound decomposition occurs when the dimethyl derivative is warmed with strong alkali. In this respect the tetramethyl derivative (see below) is much less stable and on continued heating with $N/10$ alkali it breaks down with elimination of at least three molecules of methyl alcohol.

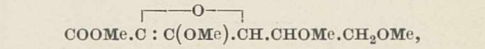


The crystalline substance, m.p. 123°, obtained by Micheel and Kraft[5] by the action of methyl alcoholic ammonia on dimethyl ascorbic acid is apparently formed in an analogous manner by the addition of ammonia to the lactone group of (III). The two methoxyl groups of dimethyl ascorbic acid are retained in the product, which we find behaves as an amide. It contains one molecule of combined methyl alcohol and has an empirical formula $C_9H_{19}O_7N$ (not $C_8H_{15}O_6N$).

The nature of the ring system (1 : 4) present in dimethyl ascorbic acid has been determined by the degradative oxidation of tetramethyl ascorbic acid, obtained by the action of methyl iodide and silver oxide on the dimethyl derivative. On treatment with ozone the tetramethyl derivative gives rise to a neutral substance (V) which reacts immediately with ammonia giving quantitatively oxamide and 2-hydroxy 3 : 4-dimethoxybutyramide. Detailed examination of the hydroxy dimethoxybutyric acid has revealed that it consists of two isomerides, the main portion (80 per cent) being 3 : 4-dimethyl-threonic acid, which we have characterised by its conversion into 2 : 3 : 4-trimethyl *l*-threonic acid (amide, m.p. 77°, $[\alpha]_D$ + 66° in water). The remainder was found to be 3 : 4-dimethyl *l*-erythronic acid (amide, m.p. 113°, $[\alpha]_D$ − 34° in water). The amides of both hydroxy acids gave sodium isocyanate on treatment with sodium hypochlorite (Weerman's reaction) and are therefore α-hydroxy derivatives. The isolation of the two epimeric acids suggests that at some stage during the series of reactions enolisation has occurred at C_4. The observation is of special interest in that any possibility of such a change taking place in the plant or animal or during the process of isolating ascorbic acid has great significance from the biological point of view.



The present observations are incompatible with the furane carboxylic acid structure for ascorbic acid advocated by Micheel[4] (which we had previously rejected for crystallographic reasons) and with the formulæ recently suggested by Karrer[6]. The oxidation results demand for tetramethyl ascorbic acid either (IV) or the structure



but apart from its inherent improbability on account of the propylene oxide ring, the latter formula is unable to explain the non-acidic character of the newly-formed first oxidation product of ascorbic acid or the behaviour of the methylated derivatives towards alkali and towards ammonia. On the other hand, all the observations offer strong support to (IV) for tetramethyl ascorbic acid and to (II) and its various tautomeric modifications for free ascorbic acid.

We wish to thank Prof. A. Szent-Györgyi for his kindness in placing at our disposal the ascorbic acid used in this work.

E. L. HIRST.
E. G. V. PERCIVAL.
F. SMITH.

Chemistry Department,
University of Birmingham.
April 7.

[1] NATURE, **130**, 888; 1932.
[2] *J.S.C.I.* (*Chemistry and Industry*), **52**, 221; 1933.
[3] *Helv. Chim. Acta*, **16**, 181; 1933.
[4] NATURE, **131**, 274, Feb. 25, 1933.
[5] *Z. physiol. Chem.*, **215**, 222; 1933.
[6] *Helv. Chim. Acta*, **16**, 302; 1933.

Vitamin B_4 and Adenine

IN a recent preliminary communication, R. Tschesche[1] has directed attention to the similarity between adenine hydrochloride and the crystals isolated by Barnes, O'Brien and Reader[2]. These crystals were specifically stated by them to have vitamin B_4 activity (10γ per diem per rat), but no claim was made that they were actually vitamin B_4. Tschesche does not state whether the specimen of crystals obtained by him was biologically active.

The general resemblance in many respects between the isolated crystals and adenine hydrochloride has been familiar knowledge in this laboratory for a considerable time. Before leaving the work in September, V. Reader tested a specimen of adenine

hydrochloride (B.D.H.) for vitamin B_4 activity with negative results. In further work it has been found that some crystalline preparations of vitamin B_1[3] in which no adenine is detectable, are still contaminated with highly active vitamin B_4.

Hence, from two independent lines of evidence, vitamin B_4 and adenine cannot be identical. The published analysis of the crystals, though showing general agreement with the formula of adenine hydrochloride, left room for difference. Further unpublished investigations by R. D. Heard and J. R. O'Brien have shown that the crystals with vitamin B_4 activity consist, in fact, largely of adenine[4]. Therefore it now remains to separate and determine the nature of the active residue. The conclusion that vitamin B_4 itself must be active in doses of less than 1γ per diem seems to be irresistible.

It may be added that, so far, irradiated adenine has not exhibited vitamin B_4 activity in our hands.

R. D. HEARD.
H. W. KINNERSLEY.
Dept. of Biochemistry, J. R. O'BRIEN.
Oxford. R. A. PETERS.
April 19. V. READER.

[1] Tschesche, *Ber.*, **66**, 581; 1933.
[2] Barnes, O'Brien and Reader, *Biochem. J.*, **26**, 2055; 1932.
[3] Kinnersley, O'Brien and Peters, *Biochem. J.*, **27**, 232; 1933.
[4] Details will be published when complete.

Absorption Spectrum of the Unsaponifiable Matter from Wheat-Germ Oil

In a recent letter to NATURE, Bowden and Moore[1] record data on the absorption spectrum of the vitamin E fraction of wheat-germ oil. So early as 1928, wheat-germ oil and extracts were studied here. The oil showed a maximum at 272 mμ ($E^{1\text{ per cent}}_{1\text{ cm.}}$ 1·9) and the unsaponifiable matter (kindly supplied by Prof. J. C. Drummond) gave evidence of maxima at 280 mμ and 256 mμ, together with weak selective absorption in the visible. On recrystallising, a white solid showing the ergosterol bands and very distinct maxima at 242 mμ and 253 mμ was obtained, whilst the more soluble coloured fraction still showed marked inflexions near 280 mμ and 256 mμ.

About the same time, a vitamin E concentrate from wheat-germ oil, made available by the kindness of Prof. H. M. Evans of California, was studied. The material was an orange solid (mainly sterol), the visible absorption of which suggested a carotenoid. The recrystallised sterol showed the four principal ergosterol bands with additional well-defined maxima at 242 mμ and 253 mμ, whilst the non-crystalline fraction exhibited an inflexion near 250 mμ.

Again last year, we examined an extract from wheat-germ oil kindly supplied by the Glaxo Research Laboratories. The alcoholic solutions showed the following bands:

λ max.	480	448	420	398	280 mμ (inflexion)
$E^{1\text{ per cent}}_{1\text{ cm.}}$	4·3	5·3	6	7	80

The material was worked up into a number of fractions without any very striking separation being achieved. The purified sterol contained small but appreciable quantities of ergosterol and an unidentified sterol showing maxima at 242·5 mμ and 252·5 mμ. An inflexion at 255 mμ appeared in some of the fractions from which sterols had been removed.

Early this year, another specimen of wheat-germ unsaponifiable matter was made available by the courtesy of British Drug Houses, Ltd. The maxima at 480, 448, 422 and 398 mμ again appeared in the crude material and in the residues obtained after recrystallisation. The sterol fraction contained ergosterol and the unidentified sterol in comparable amounts (less than 1 per cent of the gross non-saponifiable matter). The non-crystalline fractions exhibited several weak inflexions, notably at 300–310 mμ, 280–290 mμ and *c.* 250 mμ.

The observations of Bowden and Moore are thus confirmed. Further attempts at fractionation will involve high vacuum distillation of reasonably large quantities of material. Our data have not hitherto been published because no definite connexion between vitamin E and selective absorption has yet emerged.

R. A. MORTON.
J. R. EDISBURY.

Chemistry Dept.,
University of Liverpool.
April 8.

[1] NATURE, **131**, 512, April 8, 1933.

Fundamental State of Nuclear α-Particles

IT is known that γ-rays accompanying α-disintegration are due to the fact that an α-particle can escape from the nucleus with energy less than corresponds to the fundamental level, leaving the resultant nucleus in an excited state[1]. The relative intensities of these 'fine-structure' groups are given by the transparency of the potential barrier for corresponding energies $E(\alpha_n)$:

$$J(\alpha_n) = \exp\left[-\frac{4\pi e^2(Z-2)}{\hbar\sqrt{[2mE(\alpha_n)]}} + \frac{8e\sqrt{m}}{h}\sqrt{Z-2}\,\sqrt{r_{\text{eff}}}\right]$$

$$\sqrt{r_{\text{eff}}} = \sqrt{r_0}\left[1-0{\cdot}002j(j+1)\right] \quad . \quad . \quad . \quad (1)$$

where j is the azimuthal quantum number of the escaping α-particle. These intensities must rapidly decrease with energy and will be still further reduced in cases when j is not zero in the excited states; it can be calculated from (1) that this reduction will be respectively 1·3, 4, 16 and 105 times for $j=1, 2, 3, 4$. Thus we come to the conclusion that, in cases where, for normal decay, the α-particle has $j=0$, the slow groups of 'fine-structure' will be very weak.

I have shown[2], however, from the examination of irregularities in the change of nuclear radii in the different radioactive families, that for certain elements the normal group of α-particles has j differing from zero; this seems to be the case for radium-actinium, actinium emanation and also, probably, for actinium C, radium C and thorium C. This means that the nuclei of the original and resultant element possess different spins, which is not so surprising if we remember that, for example, stable nuclei such as Bi^{209} and Tl^{205}, differing only by an α-particle, have spins differing by four units (9/2 and 1/2). For such cases the relative intensity of a normal group will be considerably reduced in favour of slower groups, for some of which the spin-difference between the original nucleus and the excited state of the resultant nucleus may vanish. For such α-transformations the 'fine-structure' will be much easier to detect, as the intensities of slower groups can be even larger than for the normal one.

If we turn now to the experimental evidence[3], we

find that it is in radium-actinium, actinium emanation, and the three C-products mentioned above that relatively strong slow groups are present, while for other elements the intensities of these groups are practically on the limit of observation.

From the relative intensities of different 'fine-structure' groups of a given nucleus, it is possible also to determine the corresponding j's. For thorium C, for example, the calculated (for $j=0$) and observed intensities of different α-groups are shown in the accompanying table :

Name of the group ..	α_1	α_0	α_2	α_4	α_3
Calculated intensity (for $j=0$)	1·0	0·7	0·03	0·005	0·004
Observed intensity ..	0·3	1·0	0·03	0·002	0·02
Relative decrease ..	17	3·5	5·0	13	1

It may be concluded that for α_1 and α_4 we have $j=3$, for α_0 and α_2, $j=2$ and for α_3, $j=0$ or 1. If we assume the spin-difference between the normal state of the thorium C and thorium C″ nuclei to be 3, we arrive at the following system of excited levels of thorium C″ : $\alpha_1(S)$; $\alpha_0(p)$; $\alpha_2(p)$; $\alpha_4(S)$; $\alpha_3(d$ or $f)$.

It is not possible at the moment to compare the energy levels for all nuclei for which 'fine-structure' is found, as the experimental evidence is not yet complete. The striking similarity between the levels of the nuclei of thorium C″ and actinium X is noteworthy : these two level systems differ from one another only by 40 per cent, which is evidently connected with the change of radius by 20 per cent ($6\cdot6\times10^{-13}$ and $7\cdot9\times10^{-13}$).

If we compare, however, the levels excited by α-decay with the level system of the radium C′ nucleus[4] excited by β-decay, we find at once that the energy differences are in the last case about four times larger, which supports the hypothesis that γ-radiation by β-decay is due to proton transitions[5].

G. GAMOW.

Physico-Mathematical Institute,
Academy of Sciences of U.S.S.R.,
Leningrad.
March 17.

[1] Gamow, NATURE, **126**, 397, Sept. 13, 1930.
[2] Gamow, NATURE, **129**, 470, March 26, 1932.
[3] Rosenblum, "Str. fine des rayons alpha". Paris, 1932.
[4] Gamow, NATURE, **131**, 433, March 25, 1933.
[5] Gamow, NATURE, **131**, 57, Jan. 14, 1933.

Periodicity in the Solarisation of Calcite

REPEATED solarisation due to a prolonged exposure to the light of a quartz mercury lamp was observed by the photoluminescence exhibited by calcite from Nabeto. A definite quantity (0·045 gm.) of the finely granulated specimen was put at suitable intervals of time into the depressions of the sample holder[1] placed 15 cm. underneath the lighted lamp (100 volts, 3·1 amp.) which was employed as a constant source of exciting light. Thus a set of samples was subjected to excitation. A panchromatic plate was then applied, immediately after cessation of excitation, on the sample holder, thus charged with a set of the samples excited for discrete durations of time, the distance between the surface of samples and the photographic plate being 3 mm. After being left two hours, the plate was developed, and the photographic densities of the images generated on the plate by the action of phosphorescent light of the excited samples were determined by means of a microphotometer. The results are shown graphically in Fig. 1, which gives the growth curve of photoluminescence, indicating its periodic reversal under the exciting rays. The ordinates represent the density corresponding to the intensity of phosphorescence and the abscissæ the duration of excitation.

As will be seen, the first maximum of the intensity of luminescence appears at about two hours irradiation. With a still longer irradiation, the luminescence gradually loses in intensity owing to the solarisation of the sample. If the excitation is continued further, a minimum of the intensity of luminescence is reached at about twenty-five hours exposure, and a gradual increase of intensity is then observed again up to the second maximum attained at about thirty-three

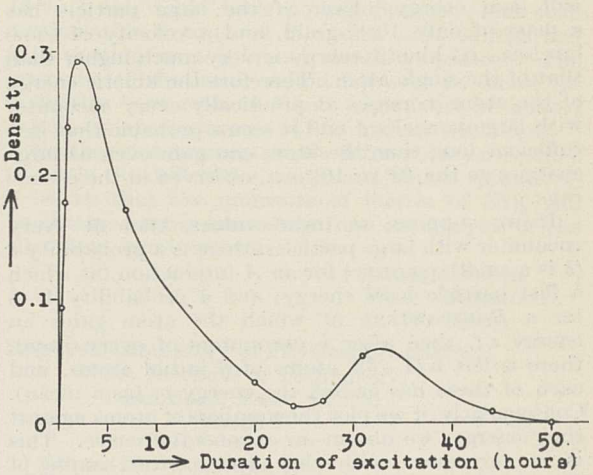


FIG. 1.

hours irradiation, after which another reversal begins again. Of course, the intensity of photoluminescence corresponding to the second maximum is very weak as compared with that corresponding to the first maximum. The result is quite reproducible with new samples.

Hence it can be concluded that the phenomenon of solarisation of calcite, by which is meant the reversal of its photoluminescence process under the continual action of the light of quartz mercury lamp, is apparently analogous in character to the well-known photographic reversal.

S. IIMORI.

Institute of Physical and Chemical Research,
Tokyo, Japan.
Feb. 2.

[1] S. Iimori and E. Iwase, *Sci. Pap. Instit. Phys. Chem. Res.*, **16**, 41 ; 1931.

Origin of Cosmic Radiation

EXPERIMENTS seem to show that the cosmic rays are very fast particles, coming from world space ; but at present there is no acceptable theory of the phenomena giving rise to them. Neither Millikan's nor Jeans's hypotheses of nuclear integration or annihilation processes, nor Regener's[1] or Swann's[2] theories, seem to be in accordance with the latest experimental results.

In world space we have a mixture of single atoms and larger particles (cosmic dust, meteors, etc.). Between the single atoms and the larger particles there can be interactions of two different kinds :

A. The single atom collides with the large particle. Then there will be an exchange of energy between the single atom and one of the atoms of the large particle. Processes of this kind will give the single atom a kinetic energy of about the same magnitude as the thermal equipartial energy of the large particle.

B. The single atom, however, can also react with the whole large particle, considered as a giant molecule. This will happen when the atom does not actually collide with, but only passes in the neighbourhood of, the large particle. The energy exchange is then due to the electrical forces. According to the gas kinetic laws, the most probable process is, that the particle with the lower kinetic energy will gain energy. Even if the large particle has a mass of only 10^{-10} gram, and a velocity of some km./sec., its kinetic energy is very much higher than that of the single atom. Therefore the kinetic energy of the atom increases at practically every encounter with large particles ; and it seems probable that in a sufficient long time the atom can gain even as large energies as the 10^9 or 10^{10} ev., observed in the cosmic rays.

If we suppose, as mean values, that at every encounter with large particles, there is a probability δ (δ is a small quantity) for an A-interaction (at which a fast particle loses energy) and a probability $1-\delta$ for a B-interaction, at which the atom gains an energy ε ; then after p encounters of every atom, there is left $n(1-\delta)^p$ atoms of n initial atoms, and each of these has gained the energy $p\varepsilon$ (as a mean). Consequently, if we plot the numbers of atoms against their energy, we obtain an exponential curve. This is in agreement with the experimental results of Kunze[3].

It seems possible, therefore, to explain the origin of the cosmic rays, introducing no new hypotheses, and only applying the kinetic gas theory to the conditions of world space.

Hannes Alfvén.

Physics Laboratory,
University, Uppsala.
March 17.

[1] *Naturwiss.*, **19**, 460 ; 1931.
[2] *Phys. Rev.*, **43**, 217 ; 1933.
[3] *Z. Physik*, **80**, 559 ; 1933.

Cathode Ray Photography of Random Electrical Transients

The recent improvements in the design of cathode ray oscillographs have naturally led to an exploration of their use for the external photographic recording of recurrent electrical events and also those of a transient nature which occur at random intervals. In the case of recurrent phenomena, such photography of the cathode ray trace is easy, but for random transients a satisfactory method must ensure that no event is missed and that fruitless exposures are few.

In some experiments carried out last summer, in collaboration with Prof. E. V. Appleton at King's College, we were concerned with the delineation of the rapid changes occurring in the earth's electric field due to both near and distant lightning flashes. These changes caused the fluorescent spot to move horizontally and were recorded on film carried by a revolving drum. By this method a resolution of pulses separated by time intervals of 20 microseconds was obtained, but it was unsatisfactory since the transient had to be anticipated and only a brief exposure was possible owing to the fogging caused by the background illumination of the tube. Methods employing a single time stroke and an electron beam trap were devised to minimise the relative intensity of this compared with the trace, but even so, distinct limitations are imposed.

These difficulties have been overcome by using the special cathode ray oscillograph supplied by Messrs. A. C. Cossor, Ltd., which gives a long after-glow of the red fluorescent trace, together with a form of circuit which gives a faithful oscillographic trace of an event, the occurrence of which is beyond the control of the operator.

The same method may be used to record the changes due to sustained or periodic phenomena occurring during a single sweep of the time base, which therefore obviates the necessity for a synchronisation of the repeated time base to obtain the steady picture necessary for a 'snap' exposure. The transient wave form remains on the screen long enough to

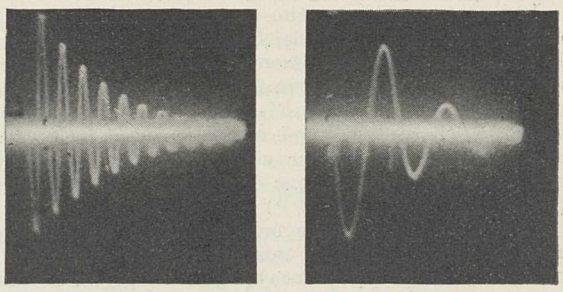


Fig. 1.

enable the camera shutter to be tripped by a thyratron arrangement actuated by a small fraction of the initial voltage. This produces no apparent distortion of the wave form. The correct brief exposure is thus made a short time after the event has finished and a second relay can be used to move the film on to the next position. A valve phase change device ensures that the shutter shall be tripped by both positive and negative initial pulses. The response of the shutter relay system occurring after the electrical event, can be made before any substantial decay of the red after-glow and therefore the exposure is made during high luminescence of the trace compared with the general background. To obtain high photographic sensitivity a camera lens having an aperture of $f/0{\cdot}99$ is used and advantage taken of the special properties of hypersensitive panchromatic film. Records have, however, been obtained on panchromatic film (H. and D. 400) using an ordinary photographic lens of aperture $f/6{\cdot}3$.

Fig. 1 shows two records, twice the size of the originals, of a condenser discharge through two different damping resistances, the exposure in each case being 1/25 sec. Records can be made on either a recurrent time base or 'tripped' single time stroke. In the case of the latter there is, however, the disadvantage that, with the present tube working at a gun voltage of 1500 volts, a stationary electron

beam is accompanied by rapid disintegration of the luminescent material at the point of incidence of the beam.

These experiments have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

F. W. CHAPMAN.

Wheatstone Laboratory,
King's College,
London, W.C.2.

Form and Vibrational Frequencies of the NO_2 Molecule

BAILEY and Cassie[1] have recently presented data on the absorption of $NO_2 - N_2O_4$ gas mixtures in the region from 2·5μ to 16μ, from which they conclude that the NO_2 molecule is linear and symmetrical. As their conclusions and in some respects their data are in disagreement with results obtained recently in this Laboratory, and earlier results[2], we wish to present briefly the facts that lead us to conclude that the atoms in the NO_2 molecule are disposed as an obtuse angle triangle. Detailed reports will be published elsewhere.

The most cogent argument against a linear model is the complexity of the fine structure of the discrete absorption bands in the visible and ultra-violet. The isolated band of NO_2 at 2491 A. clearly shows well-developed branches corresponding to rotations about two different axes of inertia, possible only if the molecule is non-linear in both the normal and excited states. We have examined the structure of the band under high resolution and find additional complexities associated with mutations about the third axis of inertia of magnitude indicating that the molecule is only slightly, but definitely, bent (apex half-angle $> 55°$) in the normal state. Weaker bands of practically identical structure occur at 751·1 and 1321·1 cm.$^{-1}$ on the long wave-length side of the 2491 A. band. Quantitative measurements of the temperature coefficient of absorption make certain that these frequency differences belong to the normal state, and are presumably the fundamentals ν_2 and ν_1.

In the infra-red we have made measurements with a prism spectrometer from 1μ to 4μ using deep layers of gas under controlled conditions and find a number of bands which we can definitely ascribe to NO_2 or N_2O_4. Those found in NO_2 and the bands found earlier above 4μ can be accounted for as combinations and overtones of fundamentals 751, 1321, and 1621 cm.$^{-1}$. The last fundamental corresponds to the strongest band found at 6·17μ by Warburg and Leithauser and checked by Bailey and Cassie. Frequencies equal to the sum of observed frequencies are found, again excluding the possibility of the linear structure. However, it should be stated that we can also account for all our infra-red bands by using the two frequencies suggested by Cassie and Bailey and assuming an inactive frequency of 1010 cm.$^{-1}$. The infra-red data available do not permit a unique answer as to the structure.

Although lacking details of their experiments, we think it possible to reconcile Cassie and Bailey's data with our model, as follows. The band found by them at 13·4μ is in good agreement with our $\nu_2 = 751$ cm.$^{-1}$, the deformation frequency; that at 6·17μ is the ν_3 fundamental. The fundamental band corresponding to our $\nu_1 = 1321$ cm.$^{-1}$, which should occur at 7·58μ, is missing. Inasmuch as the molecule is only slightly bent, we would expect this band to be the weakest fundamental; and it appears that the amount of gas in the absorbing layer was sufficient to bring out only the strongest bands, since they failed to report the strong 3·43μ band.

All the other bands, and possibly these also, may be ascribed to the N_2O_4 molecule, if the term molecule is not too definite to apply to what may be viewed as a more or less short-lived partnership of two NO_2 groups. In our infra-red work it is found that all the frequencies of NO_2 appear again in N_2O_4, indicating that the association bond is not strong enough to change appreciably the binding within the NO_2 groups. In addition, N_2O_4 has bands due to the extra degrees of vibrational freedom.

On our interpretation, calculation of the moment of inertia of NO_2 from the doublet separation of the 15·6μ band would have no significance; and such a calculation from the 6·17μ band must be regarded with caution, as a Q branch should be present. The intensity of the latter would however be small for a slightly bent molecule[3] and might well be missed except by spectrometers of the highest resolution.

Further measurements in the infra-red are necessary to settle the difficulties mentioned above. However, it seems that the moments of inertia of NO_2 will be obtained most accurately from an analysis of the electronic band spectra.

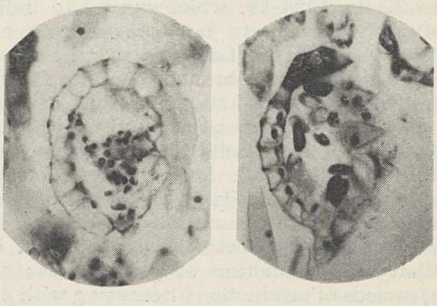
LOUIS HARRIS.
W. S. BENEDICT.
G. W. KING.

Research Laboratory of Physical Chemistry,
Mass. Institute of Technology,
Cambridge, Mass., U.S.A.
March 7.

[1] NATURE, **131**, 239, Feb. 18, 1933.
[2] Warburg and Leithauser, *Ann. Physik*, **28**, 313; 1909. Daniels, *J. Amer. Chem. Soc.*, **47**, 2856; 1925. Harris, *Proc. Nat. Acad. Sci.*, **14**, 690; 1928. Herrmann, *Ann. Physik*, **15**, 89; 1932.
[3] Gerhard and Dennison, *Phys. Rev.*, **43**, 197; 1933.

Sporangia containing Spermatozoids in Ferns

ALTHOUGH ferns have in a few instances shown some irregularities in the development of the haploid and diploid generation, such as appertain to apogamy



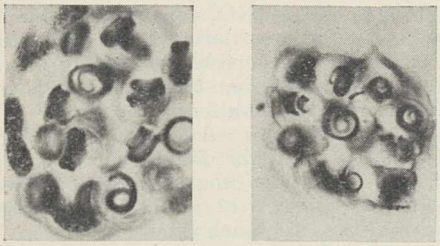
(*a*) (*b*)

FIG. 1. Sporangia with (*a*) spermatozoids, (*b*) spores. × 1350.

and apospory, there has so far been little concrete evidence to homologise the sexual organs (or their content) with sporangia (or their spores) in ferns. The fact that spermatozoids have now been found in normal sporangia of *Scolopendrium vulgare* may

thus be of some interest from the phylogenetic point of view and may throw more light on the alternation of generations, which in ferns is of such a stable and characteristic type.

Only a small number of sporangia with spermatozoids have been found among the usual sporangia with spores. Both occur in the same sorus and are equally well developed as to stalk, wall, sequence of divisions, etc. The only difference is that about sixty (in one case possibly only thirty-two) spermatozoids develop instead of the sixty-four spores. In



(*a*) (*b*)

FIG. 2. Photomicrographs of spermatozoids in (*a*) sporangium, (*b*) antheridium. × 4200.

one instance, spermatozoids were almost certainly formed when the cells were still joined in tetrads.

These exceptional sporangia have now been observed in fixed material of four normal, fully fertile hybrids between the so-called 'peculiar' and the normal type of *Scolopendrium vulgare*[1]. It is probable that the phenomenon has something to do with the curious life-cycle of the 'peculiar' type.

ALICE E. GAIRDNER.

John Innes Horticultural Institution,
Merton.
March 3.

[1] Andersson-Kottö, I., *Svensk Bot. Tidskr.*, **26**, Hft. 1–2; 1932.

Lunar Periodicity in Reproduction

IN view of the recent correspondence in NATURE[1] bearing on the question of reproductive periodicity in organisms, I should like to direct attention to some observations made by Miss S. M. Marshall and myself in Australia in 1928–29, which appear to indicate a type of such periodicity not previously recorded. In shallow pools on the Low Isles coral reef, one of the common corals is the branched species *Pocillopora bulbosa*. On some occasions, collections of branches of this coral will give off large numbers of planulæ; at other times, large collections of branches will give off no planulæ at all. During the period August 1928 to July 1929, about eighty collections of branches were made, representing hundreds of colonies. When the results of these collections were plotted, it was found that the production of planulæ was discontinuous, periods of production alternating with periods of no production. In the months December to April the productive periods occurred at about the time of new moon; in July and August at about the time of full moon; and in May and June a transition period was demonstrable from new moon to full.

I do not wish to emphasise this result too much, since the number of data is smaller than is desirable; but I am doubtful if it is possible to escape the conclusion that this coral breeds at Low Isles at about the time of new moon during part of the year, changing over to full moon for another part. There was a coincidence (but quite possibly no causal connexion) between this cycle and the behaviour of the tides, the lowest springs occurring during the winter months (May to October) at *new moon* and in *daytime*; during summer at *full moon* and *at night*.

If this interpretation of the records is correct, a change-over of the type described introduces yet another complication into the already difficult problem of finding any general explanation of the facts of lunar periodicity. A full account of the evidence here mentioned, together with information about the breeding of other corals and reef-animals, will be found in forthcoming reports of the Great Barrier Reef Expedition of 1928–29 (British Museum, Nat. History), vol. III, No. 8, and a subsequent report not as yet complete.

T. A. STEPHENSON.

Zoology Department,
University,
Cape Town.

[1] NATURE, **129**, pp. 344, 473, 543, 612, 655, 868, 906; 1932. **130**, pp. 23, 169, 243, 366; 1932.

"The Case against Einstein"

NOTHING is more difficult than with good grace to protest against an unfavourable review of one's work, but again nothing is more characteristic of mawkish sentiment than to refrain on that account from asserting a point of interest to science.

In "The Case Against Einstein" I dealt with a phase of scientific thought that has received immense publicity, and that, if valid, would give for all time its own direction to physical research and mathematical investigations. This theory I have criticised in a close and minute discussion of the crucial questions in the psychological, physical, and mathematical domains, and I have advanced arguments which, true or false, are there expressed in lucidity and in rigorous form. If my reasoning is false, I have done nothing at all; if true, I have demolished the whole system of relativity and removed an incubus from the minds of students of physics all over the world. Incidentally, I have also indicated new forms of analysis which, applying to all sciences, have a direct bearing on this subject.

To this aspect of the exposition the reviewer of my book in NATURE of February 25, p. 260, has paid no attention whatever; he has devoted the very short notice accorded the book to a complaint against the "emotional" style of my writing. The emotion, consisting mainly of laughter, was directed against the tendency which I believe to prevail, even in high scientific circles, of judging a work of science, not on its intrinsic value in regard to science, but by influences, moral or immoral, which have nothing to do with the scientific merit. The "emotional" part of my book was necessary to combat the enormous popular prestige that Einstein's doctrine has acquired, so as to enable me then to focus on the essential issues involved.

ARTHUR LYNCH.

80 Antrim Mansions,
Haverstock Hill, N.W.
March 26.

Research Items

Great Bear Lake Indians. The Annual Report for 1931 of the National Museum of Canada contains an ethnographical study of the Great Bear Lake Indians of the Mackenzie District, North-West Territories, by Dr. Cornelius M. Osgood, undertaken for the Museum between May, 1928, and September, 1929. The Great Bear Lake is the focal centre of four tribes of the north-eastern Athapascans, well known in Canadian history as the Dogribs, Yellow Knives, Hares and Slaves, with the Satudene or Great Bear Lake Indians in the centre, who though politically, socially and linguistically distinct from the Hares to-day, may have become so only within the last hundred years. The tribal boundaries represent the extreme range of the tribes, but they occupy and hunt over a very small section only at any one time. Owing to climatic conditions, the food problem is insistent. It imposes a migratory habit, and at times under stress has led to cannibalism. When food is plentiful the Indians eat enormously, but no food is laid up against scarcity, as among the peoples of the Pacific coast. This in part is due to difficulty of transport, as they have to move from one place to another seasonally according to the habitat of their food supply, fishing in one place in winter, another in summer, visiting another to obtain skins for clothing and so forth. Individual effort to attain personal security, in view of the communistic habit of the tribes, is regarded as anti-social. The principal article of diet is fish, taken in winter by nets ingeniously spread under the ice. Next come moose and caribou. The moose is shot. The caribou was formerly taken by stalking, decoying, impounding, snaring and spearing. The hunting was a communal affair, initiated by the two most important men, the best hunter and the oldest man, the latter being assigned the meat for distribution. There is no individual ownership of hunting grounds. A variety of minor animals and birds was eaten. Franklin (1828) records the eating of a special kind of clay in times of scarcity or, as a chewing material, for amusement.

Archæology of the Marianas Islands. Miss Laura Maud Thompson has published a study (Bull. 100, Bernice P. Bishop Museum) of a collection of more than 9,000 archæological specimens and field notes made by Comdr. Joseph Thompson, and Mr. and Mrs. Hans Hornbostel in the Marianas, which is now in the Museum at Honolulu. The collection includes monuments, potsherds, stone implements, and skeletal remains as well as texts with translations, maps, photographs, etc., illustrative of the former culture of the Chamorro. The Marianas are of outstanding importance for the ethnology of Oceania, as they stand at the extreme north-west of the Micronesian culture area. No detailed account of this culture has previously appeared. Pure-blooded Chamorros became extinct at the end of the seventeenth century, when nearly all the males were exterminated in a religious war between natives and Spanish missionaries. Of the Chamorro culture only the language remains but slightly altered. One of the most striking features of the ancient culture is the stone monument. In Guam the stone monuments occur along the shores and in the well-watered lowlands of the interior. Double rows of upright stones are associated with caps and are accompanied by burials, potsherds, and stone and shell implements. One of the most extensively excavated sites is that of Epau, on the north-west coast. It consists of two straight parallel rows of roughly cut coral uprights, four in each row, placed in a rectangular plan with axis parallel to the shore. On the surface of the ground near each upright is a coral head-cap which apparently has fallen from its position on the upright. The uprights are about 11 ft. apart with a distance of 12 ft. between the rows. Large retaining stones support each upright. Here seventeen extended burials were found, head to south-east but facing south-west (left). They were of different ages and of both sexes. At head, chest and knees were scattered bones, potsherds, stone implements, shell scrapers and slingstones. Six skeletons had parts missing, in one instance the skull, and five showed marks of fire.

Jumping Rodents. A. B. Howell (*Proc. Amer. Acad. Arts and Sci.*, **67**, No. 10; 1932) has undertaken a detailed anatomical examination of the kangaroo rat, *Dipodomys*, of the New World and of the jerboas of the Old World, with special reference to the structural modifications due to jumping and to the convergence exhibited by these two groups of rodents, which belong respectively to the families Heteromyidæ and Dipodidæ. An account of the habits precedes the anatomical description. In both groups there is some broadening of the face and a progressive weakening of the masticatory musculature, but the first of these changes is probably correlated with the enlargement of the tympanic bullæ. The neck, always short in rodents, has undergone further shortening and there appears to be also a shortening of the body with increased saltation and an increase in the strength and complexity of the back musculature associated with its use, in connexion with the hind limbs, in leaping. There is a decrease in the length and robustness of the arm and an increase in the length of the leg. The progressive elongation of the hind limb is especially marked in the pes, involving both metatarsals and digits. The breadth of the pes decreases and there is compaction of the bony elements resulting, in the most specialised forms, in fusion of the central metatarsals, and there is a tendency toward reduction and eventual elimination of the lateral digits. The perissodactyl type of foot is eventually attained, save that in the most highly specialised forms the third digit is more slender than the second and fourth, but in these cases the three middle digits tend to become grouped into a functional unit. The result of these specialisations is the assumption of a bipedal, saltatorial, digitigrade gait. The most specialised of the jerboas are far in advance of the kangaroo rats in saltatorial features. The most generalised of the Heteromyidæ are not discernibly fitted for leaping so that within this family saltatorial specialisation varies from little to much; the Dipodidæ are all highly specialised and would appear to have been exposed to saltatorial influences for a longer period of time.

Insects of the Marquesas Islands. Under the title "Marquesan Insects—1." (1932) the first of a series of bulletins dealing with collections made in the Marquesas and Society Islands has recently come to

hand. It is issued by the Pacific Entomological Survey which is supported by grants from the Hawaiian Sugar Planters' Association, the Hawaiian Pineapple Canners' Association and by contributions from various sources made available by the Bernice P. Bishop Museum. The Marquesas Islands were selected for first consideration on account of the rapid floral changes known to be taking place in that group and its probable repercussion upon the fauna. Furthermore, the biology of this isolated archipelago seemed to afford valuable opportunity for zoogeographical study. Most of the collecting was done by Messrs. E. P. Mumford and A. W. Adamson and the specimens are being deposited, as worked out, in the Bishop Museum, Honolulu. Some twenty-seven papers are contained in the present part and are written by various authorities on the different groups of insects concerned. Special interest is attached to Dr. R. C. L. Perkins's descriptions of two species of weevil-like beetles of the genus *Proterhinus*, which is centred in Hawaii with but few forms known outside that group of islands. Among the termites, which were hitherto unknown from the Marquesas Islands, seven species are brought to notice, by Mr. S. F. Light, of which three are regarded as new. Dr. W. M. Wheeler writes on ants, a number of new Diptera are described by Mr. J. R. Malloch and, among other contributions, are two papers of Mr. G. F. Ferris on ectoparasites. The publication is issued by the Bernice P. Bishop Museum, Honolulu.

Periodicity in Tree Growth in the Tropics. An interesting contribution on this subject by Jean Schweizer, of Djember, Java, has appeared (*Mitt. Naturforsch. Ges. Bern*, 1932). As a result of the recent extensive vegetative propagation of *Hevea Brasiliensis*, it is now possible to compare the behaviour of clones, propagated from the same individual, under widely different conditions of cultivation and climate. The author has thus been convinced that individual differences as to time of leaf production, length of rest period, etc., are inherited characteristics although they may be modified by climate, altitude, manurial treatment, etc. He points out that the rest periods of seedlings of *Hevea* are comparatively short, and two or more crops of foliage may be developed in the year, but that the rest periods increase in length with the age of the individual, when the periodicity tends to be linked with the annual climatic cycle. An interesting observation was the effect of manurial treatment in temporarily obliterating the markedly individual behaviour shown by the different branches of the same tree as to the period of leaf production; an individuality which reappears in later years as the effect of the manure diminishes. The results of defoliation experiments are described and shown to depend upon the periodicity of growth processes at the apex. When the new crop of leaves is expanding, the growing point is forming new leaves and at this stage defoliation has little effect on the periodic cycle. Later, the growing points are forming flower buds and defoliation during this period may postpone the rest period.

Probable Meteorite Scars in Carolina. In 1930 some peculiar elliptical depressions occurring in South Carolina were photographed from the air. A careful study of the photographs showed that the origin of these 'bays', as they are called locally, presents problems of extraordinary interest. F. A. Melton and W. Schriever visited the region in the following year and their account of the observations made and conclusions reached is now published (*J. Geol.*, 52–66; 1933). The characteristic features and relationships of the depressions are (*a*) a smoothly elliptical shape; (*b*) parallel alignment in a south-eastern direction; (*c*) a peculiar rim of soil that is generally larger at the south-eastern end than elsewhere; and (*d*) mutual interference of outline. Consideration of all these and other related facts leads to the conclusion that the origin cannot be attributed to the operation of ordinary geological processes. A hypothesis involving impact by a cluster of meteorites is presented as affording the most reasonable explanation. The supposed swarm must have been large enough to possess a cross-sectional area of the order of 50,000 square miles at right angles to the direction of movement. Similar features are not known to exist elsewhere on the earth's surface. The depressions are, however, so inconspicuous to observers on the ground that even the topographic surveyors seem to have failed to see their significant characters. Aerial surveys in other coastal plains may therefore disclose the existence of similar scars that have hitherto been overlooked.

Geology of South Africa. At the meeting of the Geological Society of South Africa on November 14, 1932, Dr. S. H. Haughton recorded the results of the revised survey of the Cape Town–Stellenbosch area. The succession of the pre-Cape rocks is thus pictured: (1) Deposition of the Malmesbury sediments with local volcanic activity shown by amygdaloidal lavas, obsidians and agglomerates. (2) Accumulation of the French Hoek volcanics of the Simonsberg area, consisting of felsitic lavas and tuffs and some quartz-porphyries. (3) Formation of the French Hoek Beds: conglomerates, arkoses, grits and shales. (4) Folding and shearing of the above deposits. Intrusion of the granite, which mainly invaded the older Malmesbury beds, followed by quartz-porphyry sheets in the newer French Hoek beds. (5) Erosion, followed by the deposition of the Klipheuval sediments. (6) Movement and possible faulting of all the above. Some of the faulting, however, is post-Cape, as the Table Mountain Sandstone is also affected. It is shown that there is a marked similarity in lithological characters and sequence of events shown by the Malmesbury, French Hoek and Klipheuval beds of the Western Province with those of the Pretoria, Rooiberg and Waterberg series of the Transvaal. Dr. Haughton's paper will appear in the *Transactions of the Geological Society of South Africa*.

Steam Tables. The American Society of Mechanical Engineers, with the support of the steam power industries, has taken steps to secure greater reliability in steam tables, and the first contribution to this desired end is a paper in the February issue of the *Journal of Research* of the Bureau of Standards by Messrs. N. S. Osborne, H. F. Stimson, E. F. Fiock and D. C. Ginnings, describing their measurements of the pressure of saturated water vapour from 100° C. to 374° C.—well above the critical point. The static method is used, about 300 gm. of air-free water being enclosed in a shell of chromium-nickel-steel, the temperature of the surface of the water being determined by a platinum resistance thermometer supplemented by thermo elements of 'chromel' and 'copel', and the pressure

by a piston loaded with weights. The results are given in tables, the temperature in International Centigrade degrees, the pressure in centibars, and in standard atmospheres and kilograms per square cm. for gravity 980·665. An additional table gives the temperature in Fahrenheit degrees and the pressure in lb. per sq. in. for gravity 32·174. Rates of change of pressure with temperature are also tabulated for thermodynamical purposes. None of the usual formulæ gives the pressure correctly over the whole range of temperature and the authors use a five constant formula with different constants for the ranges 100°–275° C. and 275°–374° C.

Reaction between Hydrogen and Oxygen. Hinshelwood, Moelwyn Hughes and Rolfe (*Proc. Roy. Soc.*, March) have studied the reaction between hydrogen and oxygen in a hot silver vessel. At a temperature of 650° the reaction remained fairly slow, though in a silica vessel at this temperature it would be unmeasurably fast. The explosions which occur for the silica vessel when the pressure lies within a certain range were not obtained with the silver vessel. The reaction always showed behaviour characteristic of a pure surface reaction, and the authors conclude that the silver surface has a powerful effect in breaking reaction chains which are the mechanism of a rapid reaction in the gas phase.

Study of α-Particle Groups. A recent paper from the Cavendish Laboratory deals with the analysis of α-particles by an electromagnet of new design (*Proc. Roy. Soc.*, March). The magnet consists of two bell-shaped pole pieces with a central core carrying the windings. The bells are placed mouth to mouth and an annular region of strong magnetic field is formed between their edges. A field of 10,000 gauss may be produced over an annular region 80 cm. in diameter, 5 cm. wide and 1 cm. deep with an energy of only 200 watts, and α-rays may be analysed by semi-circular focusing as in familiar β-ray apparatus. The source is placed in the annular gap, and diametrically opposite there is a small ionisation chamber connected to a valve amplifier and counting system. Successive groups of α-particles are focused on to the slit of this chamber by adjusting the magnetic field. An arrangement of search coils, fluxmeter and compensating circuit is used to measure the changes in the field. The results obtained are comparable with those obtained by Rosenblum using the great Paris magnet. The fine structure of the α-rays from thorium C is revealed, and the long-range α-particles from radium C^1 and thorium C^1 can be studied. The interest of the investigations lies largely in the relation between α-ray and γ-ray energies, and in some cases satisfactory correlations have already been made between the quantum energies of γ-rays and the energy differences between α-particle groups.

Astronomical Topics

Astronomical Notes for May. Venus is an evening star, but too near the sun for convenient observation. Mars and Jupiter are approaching each other in Leo, but do not reach conjunction until June 4. Mars is 47′ north of Neptune at 8 p.m. on May 16; this may aid observers without circles in identifying Neptune. Saturn, in the eastern part of Capricornus, may be seen after midnight; it is still too far south for convenient observation in England.

The times of disappearance, as seen from London, of four stars occulted by the moon are May 3, 10.31 p.m.; May 5, 8.57 p.m.; May 30, 10.21 p.m.; May 31, 10.17 p.m.; the magnitudes are 6·7, 5·5, 6·2, 7·0.

Two comets are within reach of moderate instruments. Comet Geddes is in Canes Venatici; an ephemeris is given in the B.A.A. Handbook. Comet Pons-Winnecke is in Aquarius; the following ephemeris is for 0^h on the days named:

	R.A.	Decl.
May 4	20^h 56^m 16^s	N. 1° 48′
8	21 17 20	N. 0 25
12	21 36 44	S. 1 1
16	21 56 32	S. 2 28
20	22 15 46	S. 3 55

It is in perihelion on May 18, at a distance from the sun of 102 million miles; this distance has increased by 6 million miles during the last revolution, owing to large perturbations by Jupiter.

To reduce to Summer Time, add one hour to all times given.

Faint Stars with Common Proper Motion. W. J. Luyten has recently published a paper describing a research that he has made with a blink microscope of plates of the region within 30° of the south pole (*Mon. Not. Roy. Astro. Soc.*, Jan.). It contains a list of stars which are concluded to be physically connected from the fact that they have common proper motions of considerable size. The paper attempts to find the probable distances and masses of the stars from a careful statistical study. There are seventy-three pairs which may be confidently taken as physically connected; a few of these had been already announced by other observers.

Two of the new pairs appear to show appreciable orbital motion in the interval of twenty-nine years between the plates; their periods are roughly estimated as 2½–3 centuries, and their parallaxes as about 0·1″ (deduced statistically, not by measurement). Both appear to be dwarf pairs, of the type of Kruger 60; they would repay visual measures with large instruments.

New Proper Motions of Stars from Bergedorf Observatory. Band 7, No. 37 of the *Bergedorf Mitteilungen* contains the seventh instalment of the "Eigenbewegungs-Lexicon". There are 3,757 new proper motions of stars (mostly faint) in the hours 4 and 5 of right ascension. Altogether 45,204 proper motions have now been published in this series. The present list has been compiled by C. Vick under the direction of Prof. R. Schorr. The declinations of the stars lie between 90° North and 1° South; they are arranged in degrees of declination, the reference numbers of the Bonn Durchmusterung being given.

For nearly all the stars observations in the present century are available; the dates of the latest observations for each star are given. Reference is made to the "Geschichte des Fixsternhimmels" for the early observations; the proper motion lists are designed to be used in conjunction with the "Geschichte". They give the magnitudes, the number of observations used for each star, and the proper motion in R.A. and declination in 100 years. No stars with less than three observations are included; generally there are four or five.

Pilot Balloon Observations at Mauritius*

THE study of the upper wind currents over Mauritius with the aid of pilot balloons was begun in July 1925, and the results obtained in the early years have been discussed by Walter and McCurdy (Geophysical Memoir No. 39 of the British Meteorological Office and Miscellaneous Publications of the Royal Alfred Observatory, No. 9 are two of the papers dealing with this subject). In Part 1 of the memoir under review is summarised all the ascents from July 1928 until December 1929 in tables giving the speed and direction of the wind mostly for steps of 500 or 1,000 metres height; and also, in the form of monthly means and frequencies, the results of recent and earlier ascents. As many as 28 ascents have reached a height of 8,000 metres and 80 a height of 6,000 metres; the general summary is taken up to 8,000 metres.

In Part 2 the results are discussed. This discussion is much more thorough than is usual in such work. It is an endeavour to "build up a scheme of the upper wind structure within the tropics and show how the scheme is modified by the seasons", to quote the authors' own words. In it they remark that meteorologists appear to be diffident in applying the geostrophic wind formula—which covers the case of air motion along a great circle—to regions within the tropics, and that their own experience has suggested to them that the isobaric chart between latitudes 5° and 25° S. is normally composed of "straight isobars", to which the geostrophic formula applies, and that the observed winds fit the isobars "at least as well, both in speed and direction, in latitude 5° as in latitude 50°".

They then proceed to derive from the geostrophic formula an expression for the height of the reversal layer between the lower easterly and the upper westerly wind currents over that part of the tropics that lies more than 5° from the equator. The formula obtained is as follows:

$$-\frac{H}{67{\cdot}4} \cdot \frac{P_0}{(T_h)^2} \cdot \frac{dT_h}{d\lambda} = \frac{dP_0}{d\lambda}$$

where H is the height of the reversal layer in metres, T_h is mean temperature of the air from the surface to height H, in degrees Centigrade absolute, λ is latitude, and P_0 is pressure at sea-level, in millibars.

The values given by this equation after various plausible assumptions such as the constancy of mean horizontal temperature gradients at all heights (based on the known smallness of horizontal temperature gradient at the surface over the tropical oceans, and the probability that lapse-rate varies very little) range from 17,700 metres in latitude 10° to 3,200 metres in latitude 20°.

The authors compare the theoretical figures with those found over various tropical islands, for example at Apia, Guam and Honolulu, and allowing for the seasonal disturbance caused by the shifting of the thermal equator with varying declination of the sun, obtain fair agreement on the whole, though the figures are not applicable in the neighbourhood of large land areas. The work concludes with diagrams showing the observed seasonal variation in the height of the reversal layer over Mauritius, monthly means of velocity up to 8,000 metres, and wind roses up to the same height.

The mathematical analysis in this memoir may possibly be open to criticism here and there, but a serious attempt to go beyond the descriptive stage and to relate local conditions with the general atmospheric circulation is rarely made in papers dealing with upper winds, and is particularly welcome when the region studied forms part of an immense area for which few meteorological data relating to such winds are available.

* Miscellaneous Publications of the Royal Alfred Observatory, No. 11. "Pilot Balloon Observations at Mauritius." By R. A. Watson and N. R. McCurdy. Pp. 17+3 plates. (Mauritius.)

Sexual Cycle in the Rhesus Monkey

DR. CARL G. HARTMANN has recently published* an account of his detailed investigation of menstruation and pregnancy in the monkey, *Macacus rhesus*. Corner's generalisations concerning the cellular content of the vagina of the monkey are fully corroborated; the leucocyte number falls near the middle of the cycle and the number of cornified cells rises to a peak near the end of the interval. Instead of the vaginal smear method, vaginal lavage has been adopted and has proved more instructive since it enables the cells to be studied in the living condition, vitally stained with methylene blue, which also affords a ready means of differentiating the kinds of cornified cells in the vaginal lumen. The amount of desquamation from the vaginal wall can be quickly read off, after lavage, in terms of the percentage of sediment in the collecting tube. Because of the constancy and reliability of the curve of vaginal desquamation as compared with the character of the cornified cells and leucocytes recovered, the latter are no longer studied and recorded; the amount of desquamation and of uterine bleeding are the two principal factors now studied in menstruating females. When the vagina is practically free of desquamated cells the animal is at a low ebb sexually, and the uterus and ovaries are small and hypofunctional.

Forty-two females, mostly full grown, have furnished data for more than seven hundred menstrual cycles—from a few to fifty-one for the individual females. The average of four hundred cycles for twenty-two of the more vigorous females is twenty-seven to twenty-eight days, but the variations are wide. The average duration of flow approaches four to six days. Dr. Hartmann's paper adds to the literature several hundred proven cases of menstruation without ovulation; the same individual, with regular menstrual rhythm, may alternate ovulatory with non-ovulatory cycles. From an inspection of the ovaries in summer and in winter it was found that the almost complete sterility of the female Rhesus in the warm months of the year was due to her failure to ovulate. A tentative estimate of the age of puberty (the time of the first menstruation) and of maturity (the capacity to ovulate and conceive) is three and four-and-a-half years respectively.

* Carnegie Inst. of Washington: Contributions to Embryology, vol. 23, No. 134, August, 1932.

Precise data can now be presented on ovulation and conception-time in a menstruating primate. The most exact figures relate to nearly forty cases in which the day of ovulation was precisely determined by palpation, and information almost as exact was furnished by nearly fifty conceptions based on limited mating periods. The optimum conception day is the end of the thirteenth or the beginning of the fourteenth day. The ovaries do not necessarily alternate in ovulation; alternation is the more usual condition but the same ovary may discharge an egg twice or even thrice in successive cycles. The placental sign—due to the leakage of blood into the uterine lumen from dilated uterine glands about the site of implantation, occurred in all the cases of pregnancy observed. The sign is as infallible in the monkey as in the rat, and begins about the time the menses of the animal are due, on the average seventeen days after conception.

The span of gestation in Rhesus, based on thirty cases, is on the average 164 days, but varies with the physique of the individual—the more vigorous individuals keep the fœtus longer. A 6 per cent longer time *in utero* was associated with 26·5 per cent greater birth-weight; the latter is not considered a consequence of the former but both as a function of vigour on the part of the mother. All the mothers nursed their babies when these were viable. Seven months seems to be the usual length of time in which lactation inhibits the menstrual cycle; then cyclic manifestations increase gradually, the ovaries and uterus increase in size, but ovulation may be delayed for months although the menstrual cycle proceeds more or less regularly.

Rectal bimanual palpation of the genital organs is easy to carry out in Rhesus and gives very accurate information about the condition of these organs. It is possible not only to differentiate ovulatory from non-ovulatory cycles but also to determine the exact time of ovulation by the very evident change in size and consistency of the ovary with the collapse of the follicle. After the collapse of the Graafian follicle the corpus luteum may be felt growing from day to day and the uterus keeps pace. Pregnancy may be diagnosed by rectal palpation with relative certainty by the nineteenth day and with practical certainty by the twenty-first day. On the basis of twenty pregnancies a chart has been constructed in which the size and consistency of the uterus and the size of the fœtal head are recorded as found at each of the twenty-three and a half weeks of pregnancy, and the author states that this should enable the investigator, after a single palpation of a pregnant female, to predict the approximate date of birth. The paper is illustrated by six plates and ten figures in the text, and protocols are appended.

Fuel Research

THE Annual Report of the Fuel Research Board for the year ending March 31, 1932 (H.M. Stationery Office. 2*s*. net) refers to the incidence of the financial crisis, which necessitated a retardation of those branches of its activities which seemed less likely to produce immediate practical results.

Apart from the carbonisation plant, referred to below, considerable attention has been given to the study of tar, the most advantageous disposal of which is vital to an industry of low temperature carbonisation. Work is following two lines: (*a*) hydrogenation of the tar to produce Diesel oils and motor spirit, and (*b*) fractional distillation to recover constituents of potential value in chemical industries. The production of road tar is also being studied.

Experiments on the direct hydrogenation of coal are directed towards elucidating the influence of catalysts. Yields of motor spirit up to 145 gallons per ton of coal have been obtained, but the commercial future of the process would be dependent on the existence of a subsidy. The Coal Survey of Great Britain has now been extended to cover the whole of the national coal areas, and progress is being steadily made. This is one of the Board's most valuable tasks, for only those who have considered the selection of coal for special purposes know how limited has been the supply of authenticated data.

The Fuel Research Board has made carbonisation at low temperatures, especially in continuous vertical retorts, one of its chief studies. Cast iron retorts did not prove commercially successful but a new design of firebrick retort has been developed which, after two years' working, is considered very promising. An account of experience with them is given in Fuel Research Technical Paper No. 35, "Low Temperature Carbonisation. Narrow Brick Retorts at the Fuel Research Station" (H.M. Stationery Office. 6*d*.). A wide range of coals—even the most strongly caking—has been successfully carbonised at reasonable speeds, yielding products of satisfactory quality. The use of firebrick instead of iron has been advantageous in allowing the use of higher temperatures, which relieves the operator from many of his anxieties. The report prompts the conclusion that the plant in its evolution tends to approach existing designs of commercial carbonisation plant.

Genetic Studies on *Drosophila**

THIS work referred to below is divided into three portions, dealing respectively with inverted sections of the autosomes in *Drosophila melanogaster*, with translocations between the second and third chromosomes, and with two new lines in which the X-chromosomes of the female are terminally attached to each other. The treatment is highly condensed and technical, with a wealth of new breeding data and some new interpretations.

In 1921, Sturtevant suggested that cases of reduced crossing-over which appeared only in the heterozygous condition might be due to inversion of a section of a chromosome. He has since shown that several such reducers are actually due to an inverted section—so that homologous genes do not correspond in position. In the present paper, sixteen new cross-over reducers in chromosome III are investigated. They fall into three groups and nearly all are shown to result from

* "Contributions to the Genetics of certain Chromosome Anomalies in *Drosophila melanogaster*." By A. H. Sturtevant and T. Dobzhansky. (Publication No. 421.) Pp. v+81. (Washington, D.C.: Carnegie Institution, 1931.)

an inversion of a longer or shorter section. The geographical distribution of reducers in *D. melanogaster* indicates that they must arise independently and fairly frequently. In *D. simulans*, on the contrary, which has an inversion in chromosome III compared with *D. melanogaster*, this is the normal condition of the species, being found in all material collected from many different parts of the United States.

The second paper gives a genetical and cytological account of four translocations between chromosomes II and III (the long chromosomes) in *D. melanogaster*. Three of these, which arose in X-ray experiments of Dobzhansky, are called reciprocal translocations. In two of them the chromosomes both broke very close to the (central) spindle-fibre attachment, the two left halves then uniting, and also the two right halves. In the third case, the right half of chromosome III was exchanged with the terminal section of the left half of II. In another translocation, the extreme left end of II was attached to the middle of the left limb of III. These translocations are all lethal when present in the homozygous condition. In some of these translocations the pairing of the somatic chromosomes is different from that of the wild type, like regions of the chromosomes in their new positions tending to lie side by side; and in at least one, certain chromosomes are visibly different in shape from the normal. The bearing of these results on the ring formation of chromosomes in *Œnothera* is discussed.

Two lines with attached X-chromosomes are added to the two already known. They are believed to have arisen from an XX sperm. Triploidy occurred in one of these lines. and the X-chromosomes sometimes become detached, probably in oogonial cells. Three mosaic females were found, probably derived from eggs with two nuclei, as well as several mutations the genetics of which are discussed. R. R. G.

University and Educational Intelligence

Belfast.—Dr. K. G. Emeléus, lecturer in physics, who is at present in the United States with a Rockefeller fellowship, has been appointed to the chair of experimental physics in succession to Prof. W. B. Morton.

Cambridge.—W. V. Lewis, of Gonville and Caius College, has been appointed university demonstrator in geography and Dr. N. W. Pirie university demonstrator in biochemistry.

The Linacre lecture will be delivered by Prof. E. Mellanby on May 6 at 5 p.m. in the lecture room of anatomy. The title of the lecture will be "The Nervous System within the Pale of Nutrition".

London.—The following doctorates have been conferred: D.Sc. degree in biochemistry on Mr. A. G. Norman (Rothamsted Experimental Station) for a published work entitled "The Biological Decomposition of Plant Materials" (*Biochem. J.* and *Ann. Econ. Biol.*, 1929–32); D.Sc. degree in biology on Prof. R. Ruggles Gates (professor of botany at King's College) for published works entitled (1) "The Mutation Factor in Evolution" (Macmillan, 1915), (2) "Mutations and Evolution" (Cambridge University Press, 1921), (3) "Heredity and Eugenics" (Constable, 1923) and (4) "Heredity and Man" (Constable, 1929) and also about 120 scientific memoirs and papers mainly on plant genetics, cytology and human genetics; D.Sc. degree in chemistry on Mr. E. Lester Smith (Chelsea Polytechnic) for fourteen published works on the physical chemistry of soap solutions, emulsions, and the saponification of oils; D.Sc. degree in geology on Mr. B. H. Knight (University College and Chelsea Polytechnic) for a published work entitled "The Road-making Stones of Argyllshire" (*J. Inst. Mun. and City Engin.*, 1932) together with thirty-one other published works; D.Sc. degree in physiology on Mr. R. J. Lythgoe (University College) for a published work on "The Adaptation of the Eye: its relation to the Critical Frequency of Flicker" and "The Measurement of Visual Acuity" (Med. Res. Coun. Special Reports, 134 and 173); D.Sc. degree in veterinary science on Mr. S. C. J. Bennett (Royal Veterinary College) for a thesis entitled "Contagious Bovine Pleuro-Pneumonia: Control by Culture Vaccines" (*J. Comp. Path. and Therap.*, 1932); and Mr. A. W. Stableforth (Royal Veterinary College) for a published work on "Bovine Mastitis" (*J. Comp. Path.*, 1930 and 1932) and "Johne's Disease" ("System of Bacteriology", Med. Res. Coun., 1930); D.Sc. (Economics) degree on Hirendra Lal Dey (London School of Economics) for a thesis entitled "Indian Tariffs in relation to Industry and Taxation" (Allen and Unwin, 1933).

St. Andrews.—At a meeting of the University Court on April 21, a letter was read from Prof. J. E. A. Steggall intimating his retirement from the chair of mathematics in University College, Dundee, as from September 30. The Court, expressing regret at the termination of Prof. Steggall's fifty years' service in University College and its recognition of the admirable work he has done, agreed to accept his resignation and to express to him the hope that he may enjoy his well-earned retirement.

A Bayliss-Starling memorial scholarship for physiology will be awarded shortly. The annual value of the scholarship is about £120, with exemption from tuition fees, and it is tenable at University College, London. The scholar will be required to follow a course of study approved by the Jodrell professor of physiology involving a training in the principles of, and methods of research in, either physiology or biochemistry or both. Candidates for the scholarship must send their applications to the Secretary of University College, Gower Street, W.C.1, on or before May 13.

"The Crisis in Education" was recently discussed at an American Citizens' Conference convened for the purpose at Washington, and Science Service reports that, because of the value of the scientific research conducted in them and of the training for life they afford, the support of universities was strongly urged by a special committee of the Conference. Furthermore, the Conference declared that, during a period of economic stress such as that now existing, there is imposed upon all those in positions of responsibility, whether in government, industrial or cultural activity, a clear duty to promote confidence among the people in their educational institutions. A note of alarm as to symptoms of loss of such confidence is also sounded in the annual report of the Commissioner of Education.

Calendar of Nature Topics

May Sunshine

May in England is primarily the month of sunshine. Although in June the days average nearly an hour longer, the clearer skies of May almost suffice to make up the handicap, and the actual duration of bright sunshine is very nearly as great in May as in June; in some parts of the country May is even the sunnier. This characteristic of "the merry month of May" was early recognised; Shakespeare wrote: "Maids are May when they are maids, but the sky changes when they are wives." May is the last month of spring; the winds have fallen to gentle breezes, but they still blow mainly from south-west. Winds of southerly origin are generally moist, but their stratification is stable, and violent storms are rare. In June, pressure rises over the Atlantic to the west of the British Isles and the prevailing winds blow from north of west; approaching more southerly latitudes the lower layers of air are warmed by contact with the surface and tend to become unstable. Hence in June, skies become cloudier and thundery conditions begin to develop.

Swallow and Cuckoo Arrive

No migrant birds have received more general attention than these, and although consensus of opinion gives April as the usual month of first arrival in Britain, it is curious that the range within the month should be so varied. Dr. Eagle Clarke records the earliest average for the swallow as March 21 for the usual date of first arrival in England, April 6 for Scotland; Gilbert White's dates in Hampshire range from March 26 to April 20; Marwick's in Sussex from April 7 to April 27; Blomefield's in Cambridgeshire from April 9 to April 28, and the Phenological Society's average for thirty-five years works out at April 21. For the cuckoo, the corresponding average is April 26; Blomefield's average of seventeen years is April 29, his range April 21 to May 8, closely corresponding to Marwick's April 15 to May 3, less closely to White's April 7 to April 26.

Precision of Return of Swallow

One of the many interesting discoveries which the ringing method of tracing bird migration has placed beyond doubt is that swallows often return to the exact locality from which they set out in an earlier year. Dr. Landsborough Thomson has summarised the evidence from many sources. In Britain, twenty-one swallows marked as nestlings have been found again at their place of birth, seventeen in the following summer, two after two years, and two after three years, while six marked as adults have returned to the old nesting locality. Sometimes the return was extraordinarily precise, to the same porch or outhouse, sometimes to within a few miles; but occasionally a considerable distance intervened, the two greatest divergences being the return of a bird born in Stirlingshire to Yorkshire (170 miles) and of the recovery of one, born in Ross-shire, at Glasgow (125 miles) after an interval of nine years. In Hungary, von Sceöts recorded many returns of swallows and house-martins of great accuracy, and none outside a radius of two kilometres. In one instance, a bird used the same nest in six successive seasons, and a pair has been observed to keep together for three years. When it is remembered that these returns follow a double journey, to and from southern Africa, under varied conditions of wind, the precision of way-finding and the appreciation of locality take rank as outstanding wonders of bird migration.

Red Deer Shed their Antlers

Richard Jeffries states that the red deer of Exmoor shed their antlers in March, but while this is the shedding month for park deer, in general it may be said that wild stags in England cast their antlers in April and in Scotland in May. In this process, Nature seems to be in wasteful mood, for the building up of a pair of antlers weighing approximately ten pounds, largely from a material so scarce in the food of deer as lime salts, must entail a considerable physiological drain upon the stag. In less than four months, the antler will be completely formed; it will serve its purposes for the remaining eight months and then be entirely cast off.

The shedding of the antlers depends mainly upon the cutting off of the blood supply, and this is brought about by the growth of the bony tissue so that it encroaches upon the blood-vessels lying in the central mass of the antler shaft or beam. The very solid end of a shed antler represents the non-vascular tissue which, in developing, has obliterated the blood-vessels and so cut off the blood supply to the antler, causing it to become a dead structure. Then follows a process analogous to necrosis. At the junction of the antler and the process of the frontal bone upon which it rests, the bone is resorbed and an area of weakness develops, so that by rubbing its antlers against a tree or rock or even by a violent shaking of the head, the stag is able to free itself of them.

Bull Frogs Calling

By the end of April and the beginning of May, the choruses of bull frogs will be in full song in North American swamps, making noise enough to be heard a mile away and almost to deafen observers close at hand. Although frogs, as Sir J. Arthur Thomson used to put it, invented the first love song in the world, they have been able to impart a wonderful amount of variety to their croaking. The song of the Carolina toad (*Bufo terrestris*) may be no more than a slight chirp, but it has also been described, by Prof. A. H. Wright (1932), as a trill, a drone, a musical note in quality or a bass roar, to be interpreted in English (or American) as "waghrrrrrr rrrrrr"; a very different performance from that of the green tree- or 'fried bacon' frog (*Hyla cinerea*) of which the shrill, loud voice, curiously human, seems to call "grab, grab, grabit, grabit". The Carolina toad, like many of the species of *Hyla*, has a large vocal sac under its throat, and when croaking the throat is at first distended to its full capacity and the body compressed, followed by the collapse of the throat and distention of the body. The croak is of seven to nine seconds duration and is repeated at intervals of four to sixty seconds. Temperature readings during the periods of croaking varied from 58° to 88° F., but the best choruses occurred at 68° to 74° or higher. Most of the croaking was preceded or accompanied by rain, or cloudy weather, and rain appears to be the important determining factor. As the season wears on to June and July, croaking slackens in volume, and Wright's data seem to show that the later the season of chorus probably the greater the amount of rain required to give the initial stimulus.

Societies and Academies

London

Mineralogical Society, March 23. L. J. Spencer: Biographical notices of mineralogists recently deceased (fifth series). Max H. Hey: A possible source of error in the determination of symmetry from optical extinction-angles. In certain cases a small departure of a cut plate from the intended section direction may lead to comparatively large errors in the extinction angle and hence to an incorrect determination of symmetry. This is well illustrated by mesolite. Max H. Hey: Studies on the zeolites. (5) Mesolite. New analyses and X-ray studies of mesolite indicate that the correct formula is $Na_4Ca_6Al_{16}Si_{24}O_{80}22H_2O$. There is often a slight replacement of sodium by potassium, and generally an appreciable replacement of calcium by two atoms of sodium. The axial ratio has been determined by goniometric and X-ray methods. Refractive index, birefringence and optical axial angle measurements have been made. The vapour pressure has been studied by the isohydric method previously described. A number of base exchange products have been prepared and the potassium and lithium derivatives shown to be identical with those obtained from natrolite. This provides the first conclusive proof that mesolite and natrolite are, as has been commonly assumed, isostructural. X-ray photographs of mesolite are very similar to those of natrolite, but show distinct differences. The space-group is C_2'. A. E. Mourant: The dehydration of thomsonite. A study of the dehydration of thomsonite by the isobaric method. The results, obtained some years ago, are supplementary to those obtained by Hey by the isohydric method and differ from them in some respects. Dehydrated thomsonite does not absorb air. The lattice-shrinkage reaction has been further investigated. F. J. Turner: Note on the occurrence of piedmontite in quartz-muscovite-schist from the Shotover valley, western Otago, New Zealand. A description of piedmontite in schist occurring as boulders in the Shotover River. The mineral has not previously been recorded from New Zealand.

Paris

Academy of Sciences, March 13 (*C.R.*, 196, 733-820). Charles Nicolle and J. Laigret: The conservation of various types of typhus virus in the brain of infected rats and guinea-pigs. Marcel Brelot: The problem of Dirichlet. Krawtchouk: The distribution of the roots of orthogonal polynomials. Edm. Lahaye: A method of resolution of algebraical equations. Claude Chevalley: The generation of a topological group by infinitesimal transformations. Nikola Obrechkoff: Meromorph functions which are limits of rational fractions. G. Valiron: Generalisations of theorems of Lindelöf and Phragmén. E. Crausse and J. Baubiac: Transitory regimes in a cylindrical discharge tube containing an obstacle. Albert Toussaint and Henry Giberd: The measurements of the aerodynamical characteristics of the upper and lower wings of 125 biplanes. Henri Poncin: The determination of the movements of a fluid round a cavitation. B. Kwal: The trajectories of the electrons in a longitudinal magnetic field. I. I. Agarbiceanu: The action of the magnetic field on the absorption lines of iodine (I_2). G. Bruhat and A. Guinier: Improvement of the photoelectric polarimeter: the rotatory dispersion of saccharose in the ultra-violet. With the apparatus described, the errors are less than one in a thousand up to a wave-length of 2950 A. and one in five hundred below 2950 A. René Lucas and Marcel Schwob: Anomalous dispersion in magnetic and electric double refraction. A description of the experimental results obtained with fenchone and ethyl phenylsuccinate. The anomalies observed can be explained by the hypothesis of the existence of different molecular forms in equilibrium, these forms possessing Cotton-Mouton constants or Kerr constants of contrary signs. Mlle. M. Quintin: The application of Debye's theory (formula of Gronwall, La Mer and Sandved) to solutions of copper sulphate. The formula of Gronwall and La Mer does not agree well with the facts cited: three hypotheses to account for the disagreement are considered. A. Debierne: New radioactive substances. In the course of chemical treatments of radioactive minerals, the author has noted a certain anomaly in the distribution of activity, and concludes that radium is accompanied by radioactive substances not yet characterised. G. Lejeune: Comparison of the reduction velocities of solutions of ceric and perceric salts by the sugars. Jean Grard: The osmotic pressure of solutions of nitrocellulose. Comparison of osmotic pressure and viscosity of acetone solutions of nitrocellulose before and after heating to 130° C. L. Gay and J. Soulié: A boiling point apparatus for the determination of the dew points and boiling points of mixtures of volatile liquids. Among the advantages claimed for the apparatus figured and described is the maintenance of the state of equilibrium between the vapour and liquid phases, and the uniform temperature in the two phases. Mlle. Choucroun: A correct arrangement for electrophoresis. The apparatus described can be used to concentrate colloids without alteration, and to separate a mixture of two kinds of particles unequally charged. Marcel Godchot, Etienne Canals and Mlle. Germaine Cauquil: The Raman spectrum of some cyclenic hydrocarbons. Data for cyclopentene, cyclohexene, cycloheptene and cyclooctene. B. Bogitch: Roasting sulphides, particularly nickel mattes. N. Yannaquis: The polymorphism of the paraffins. V. Kunzl and J. Köppel: The constant of the crystalline network of the rhombohedral face of quartz. Raymond Hocart: The symmetry of boracite and X-rays. Jacques de Lapparent: The signification of the granulites of Brittany and the genesis of the crystallophyllian. Raymond Furon: The discovery of the fossil-bearing intrusive Cenomanian and new Turonian deposits in the Niger Colony (geological material collected by M. Auguste Chevalier). Marcel Thoral: The discovery of new fossil-bearing deposits in the Potsdamian and lower Arenig of the Montagne Noire. Mlle. G. Homery: The magnetic declination on the whole of the globe. Ch. Maurain: Remarks on the preceding note. Ladislas Gorczynski: The part of the solar radiation diffused by the celestial vault in the total insolation. L. Eblé and G. Gibault: The values of the magnetic elements at the Val-Joyeux station (Seine-et-Oise) on January 1, 1933. Charles Killian: Ecological researches on the seasonal fluctuations of chlorophyll assimilation in plants of the Algerian maquis. Raoul Lecoq: The rôle of the B vitamins in the utilisation of the glycides by the organism of the pigeon. The comparative action of levulose, glucose, galactose and of some disaccharides (holosides) incorporated in

balanced regimes, rich in lipides. P. CAPPE DE BAILLON: The formation of the egg-shell in the Phasmidæ. MME. LOUISE NOUVEL: Casting the shell of *Leander serratus* affected with the parasite *Bopyrus Fougerouxi*. The growth and casting the shell in *Leander* is in no way influenced by the presence of the parasite. J. ANDRÉ THOMAS: The pure culture of the umbilical vitellin syncytium of the embryo of the fowl. The first stages. MLLE. A. KRAMER: Contribution to the study of the heterosides of *Philyrea latifolia*. Two heterosides have been extracted from the bark of *Philyrea*, one named philyroside identical with the philyrine of Carboncelli and of Bertagnini and Luca, another proved to be identical with syringoside (syringine) isolated from various plants of the Oleaceæ. C. CHARAUX and J. RABATÉ: Contribution to the biochemical study of the genus *Salix*. Isosalipurposide. H. BORDIER: The continuity of Merget's phenomenon.

SYDNEY

Linnean Society of New South Wales, Nov. 30. H. L. JENSEN: Contributions to our knowledge of the Actinomycetales. (4) The identity of certain species of *Mycobacterium* and *Proactinomyces*. A number of organisms previously described as species of *Mycobacterium* were found, on account of their definite mycelial growth in the initial stages of their life cycles, to have their proper place in the genus *Proactinomyces*. *M. agreste* Gray and Thornton and *B. mycoides corallinus* Hefferan must be regarded as one species, *P. corallinus*. *M. salmonicolor* den Dooren de Jong is closely related to this and should be called *P. salmonicolor*. *M. opacum* den Dooren de Jong and *M. crystallophagum* Gray and Thornton are identical; this species should be called *P. opacus*. *M. erythropolis* is closely related to this; its proper name should be *P. erythropolis*. *Microbacterium mesentericum* Orla-Jensen showed a very distinct mycelial growth and should be called *P. mesentericus*. T. G. B. OSBORN, J. G. WOOD and T. B. PALTRIDGE: The growth and reaction to grazing of the perennial saltbush, *Atriplex vesicarium*. An ecological study of the biotic factor. The root system is extensive and superficial, with deciduous feeding roots. The leaves, which are non-cuticularised with a high salt content, are able to absorb water vapour from a nearly saturated atmosphere. The plant is, indeed, dependent for a portion of its water upon moisture absorbed from the air. With continued drought and loss of vegetative vigour it passes through states of wilting, defoliation and anabiosis. Moderately heavily grazed saltbush is more vigorous during a drought period than lightly grazed bush or bush that is not grazed at all. Saltbush is most profitably utilised under a system of moderately heavy intermittent grazing. J. G. CHURCHWARD: The geographical distribution of *Tilletia* species on wheat in Australia in 1931. Two species of *Tilletia*, namely, *T. tritici* and *T. levis*, are widely distributed and prevalent in most of the wheat-growing areas of Australia. This fact has an important bearing on the development of disease-resistant varieties, as it has been shown by Johnston (1924), Kienholz and Heald (1930), and Holton (1930), that varieties do not necessarily react in the same way to the two species of bunt. I. M. MACKERRAS: The Australian species of *Graphomyia* (Diptera, Muscidæ). One species of *Graphomyia* from North Australia is described as new. G. A. WATERHOUSE: Australian Hesperiidæ (3). New subspecies are described as follows: two of *Trapezites symmomus*, one of *Netrocoryne repanda*, and a new form of *Euschemon rafflesia*.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 677–730, Dec. 15, 1932). BARBARA MCCLINTOCK: A correlation of ring-shaped chromosomes with variegation in *Zea mays*. Diminution in size or loss of the ring chromosomes was observed in eight cases, seven of them the progeny of X-rayed pollen. This leads to variegation if the ring carries a 'genetic marker'. M. BIOT: Critical torsional oscillations of a rotating accelerated shaft. A theoretical discussion, assuming the forces applied to the shaft have a part (a moment of constant amplitude per unit length) varying with a frequency proportional to the angular velocity, and neglecting damping. BENJAMIN KROPP: The crustacean chromatophore activator and the gonads of the rat. Active extract from the eye-stalk of *Palæmonetes*, though like pituitrin causing melanophore movements in fishes and tadpoles, has no observable effect on the gonads of rats. MATILDA MOLDENHAUER BROOKS: The penetration of *m*-bromo-phenol indophenol and of guaiacol indophenol into *Valonia ventricosa*. Both these dyes penetrate the cells and are found inside in the reduced form. KENNETH V. THIMANN and JAMES BONNER: Studies on the growth hormone of plants. (2) The entry of growth substance into the plant. Curvature of oat coleoptiles is proportional to the concentration of growth substance supplied in solution in agar blocks. A theoretical discussion brings Went's observations, which suggested that the amount of growth substance was the effective factor, into line with the new results. HUDSON HOAGLAND: Impulses from sensory nerves of catfish. Electrical responses were recorded from lateral line nerves, spinal nerves supplying skin of flank, and branches of the facial supplying tastebuds of lips and barbels, after mechanical, thermal and chemical stimulation of the receptors. The lateral line nerve appears to be in a state of continuous spontaneous activity and the individual neuromasts can be synchronised by a tuning fork. The system, contrary to the facial and spinal nerves, seems to be a thermal receptor. KARL T. COMPTON: Accommodation coefficient of gaseous ions at cathodes. An ion entering the positive ion space charge sheath round a cathode acquires a certain momentum and strikes the cathode; after neutralisation, it may leave the cathode with appreciable energy, a point hitherto neglected. Of the impulse given to the cathode, part is exactly compensated by the mutual pull of cathode and ion during approach and the remainder alone contributes to the pressure on the cathode. The effect is described in terms of the 'accommodation coefficient' used to give the energy transfer of gas molecules at temperature T_1 striking a surface at temperature T_s and leaving at temperature T_2. GUSTAV A. HEDLUND: Recurrent geodesics on any closed orientable surface of genus one. W. J. TRJITZINSKY: (1) The general case of integro-Q-difference equations. (2) A property of indefinitely differentiable classes. H. R. BRAHANA: Operators of order p^m in the group of isomorphisms of the Abelian group of order p^n and type 1, 1, . . . MARSTON MORSE and S. B. LITTAUER. A characterisation of fields in the calculus of variations. Dealing with a geometric characterisation of focal points and conjugate points in n-space for $n>2$.

Forthcoming Events

Monday, May 1

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY, at 6—(at the London School of Economics, Houghton Street, W.C.2).—C. B. Frisby: "The Internal Economy of the Office".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. V. Coverley-Price and Miss M. McKinnon Wood: "Professor Gregory's Expedition to Peru".

Tuesday, May 2

INSTITUTION OF CIVIL ENGINEERS, at 6.—(James Forrest Lecture.) Sir Harold Hartley: "Recent Advances in the Application of Chemistry to Engineering".

Wednesday, May 3

EUGENICS SOCIETY, at 4—(at the rooms of the Linnean Society, Burlington House, London, W.1).—Annual General Meeting.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. A. Bott: "Principles of Critical Analysis in Relation to Modern Psychology" (succeeding lectures on May 4 and 5).

ROYAL SOCIETY OF ARTS, at 8.—Prince Ginari Conti: "The Natural Steam Springs of Tuscany and their Industrial Application".

Thursday, May 4

HUXLEY MEMORIAL LECTURE, at 5.30—(at the Imperial College of Science and Technology).—Prof. H. E. Armstrong: "Our Need to Honour Huxley's Will".

UNIVERSITY OF LONDON, at 5.30—(at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1).—R. Freeman: "Long Span Bridges".

Friday, May 5

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 3.15.—Dr. E. L. Middleton: "Industrial Hygiene" (succeeding lectures on May 12, 19, 26 and June 2).

CHEMICAL SOCIETY, at 5.15—(joint meeting with the University College of North Wales (Bangor) Chemical Society at the Memorial Science Buildings, Bangor).—Prof. C. S. Gibson: "The Chemistry of Gold".

GEOLOGISTS' ASSOCIATION, at 7.30—(in the Architectural Theatre, University College, Gower Street, W.C.1).—Sir Albert E. Kitson: "A Geological Reconnaissance through Kenya, British East Africa".

Saturday, May 6

UNIVERSITY OF CAMBRIDGE, at 5—(in the Anatomy Lecture Room).—Prof. E. Mellanby: "The Nervous System within the Pale of Nutrition" (Linacre Lecture).

ENTOMOLOGICAL SOCIETY OF LONDON, May 3–4.—Centenary Celebrations at rooms of the Royal Geographical Society and Lancaster House, St. James's, S.W.1.

ELECTRICAL ASSOCIATION FOR WOMEN, May 3–5. Eighth Annual Conference to be held at Birmingham. President: Dame Ethel Shakespear.

IRON AND STEEL INSTITUTE, May 4–5. Annual Meeting. W. R. Lysaght—Presidential Address.

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 2, February, Abstracts Nos. 194–373. Pp. 37–72. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Ollsgoil Na h-Eireann (The National University of Ireland). Calendar for the Year 1932. Pp. viii+299+588+260. (Dublin.)

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 44, Part 1, March 29th. Pp. 120. (London: Edward Stanford, Ltd.) 5*s*.

British Cast Iron Research Association. Special Publication No. 1. Recommended Methods for Sampling and Analysis of Cast Ferrous Metals and Alloys. Pp. 44. (Birmingham.) 10*s*. 6*d*.

Journal of the Chemical Society. March. Pp. iii+217–332+x. (London: Chemical Society.)

Quarterly Journal of the Royal Meteorological Society. Vol. 59, No. 249, April. Pp. 95–200. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

OTHER COUNTRIES

Colony and Protectorate of Nigeria. Report on the Agricultural Department for the Year 1931. Pp. ii+30. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2*s*. 6*d*. net.

Report on the Administration of the Meteorological Department o the Government of India in 1931–32. Pp. ii+34. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d*.

Government of India: Department of Industries and Labour. Functions and Organisation of the India Meteorological Department, 1933. Pp. 19. (Simla: Government of India Press.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1932. Pp. 18+5 plates. (København: G. E. C. Gad.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 10, No. 2. Pp. ii+81–303+17–27. (Tokyo: National Research Council of Japan.)

The Museum Journal. Vol. 23, No. 3: Excavations at Ur, by C. L. Woolley; The Pottery of Tell Billa, by E. A. Speiser. Pp. 185–312 (plates 26–72). (Philadelphia: University Museum.) 1 dollar.

Ministry of Public Works, Egypt: Physical Department. Physical Department Paper No. 28: The Nile Basin. Vol. 2: Measured Discharges of the Nile and its Tributaries. By Dr. H. E. Hurst and Dr. P. Phillips. Pp. ix+661. (Cairo: Government Press.) P.T. 50.

History, Ethnology and Anthropology of the Aleut. By Waldemar Jochelson. (Publication No. 432.) Pp. vi+91. (Washington, D.C.: Carnegie Institution.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 9: Nursery Schools; their Development and Current Practices in the United States. By Mary Dabney Davis, with the collaboration of Rowna Hansen. Pp. v+92. (Washington, D.C.: Government Printing Office.) 15 cents.

Smithsonian Miscellaneous Collections. Vol. 89, No. 1: Amphibians and Reptiles collected by the Smithsonian Biological Survey of the Panama Canal Zone. By Karl Patterson Schmidt. (Publication 3181.) Pp. 20. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 6: The Templeton Crocker Expedition of the California Academy of Sciences. No. 6: Formicidæ of the Temple Crocker Expedition. By Prof. William Morton Wheeler. Pp. 57–64. (San Francisco.)

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