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Transport Research in Great Britain

THE problem of road and rail traffic in Great Britain has been examined in great detail by a Royal Commission and by the Salter Conference. A measure of co-ordination was achieved by the grouping of the principal railways, and more recently, by the creation of the London Passenger Transport Board, which took control of passenger traffic in the London area on July 1. The Royal Commission on Transport did its work well, yet it has been left to Mr. Mervyn O'Gorman, in a recent article in the *Nineteenth Century*, to make the recommendation that should prove of the greatest value : guide road policy by scientific research.

The motor-car has existed as a commercial vehicle for about twenty-five years. Its development in this short time has been so rapid that it has become a competitor of the railway. Its rate of technical progress is accelerating rather than slackening, while technical progress in the railway is negligible in comparison. The railway, however, has not had the advantage of a multitude of brains working in competition. If motor-car and railway maintain their present rates of progress, there is little chance of the railway surviving unless fostered.

It is clear that something is wrong. The railway owns private tracks that are straight and level ; it owns a network of canals ; it owns harbours and docks from which it could run or control coastwise sea transport, and it has rights on the roads. An organisation that has the enormous advantage of private tracks and a choice of transport methods ought to be able to compete with one that possesses only rights on the road.

The Royal Commission on Transport and, to some extent, the Salter Conference, sought to discover what was wrong. Apart from a few minor criticisms, the defects they found in railway organisations were low speed and failure to suit the convenience of their customers. Both stated, implicitly only, that the railways must be maintained in prosperity in order that they might convey certain classes of goods at less than cost. Neither considered whether the railways were making the best use of their facilities, and it transpired in evidence that the only important step that was being taken by the railways to meet road competition was to run on the roads themselves, neglecting their asset of private tracks.

Speed stands out as the prime factor in

attracting custom. Speed must not be measured solely by the time of transit at one hour of the day; frequency of service must enter into it. Nor must it be measured by the time from one station or coach terminus to the other, but from door to door. Speed in this sense, is, on the average, considerably higher on the road than on the railway, both for passengers and goods (Mr. O'Gorman puts speed on the road at twenty-four times speed on rail), and this is probably the main reason for the success of road traffic. The effect of increasing speed by electrification of suburban railway lines is shown in a statement of the Southern Railway; the number of passengers (other than season ticket holders) on a recently electrified line, increased by 58 per cent after nine months' running.

How to increase speed is a technical problem. Forgetting for the moment technical difficulties and organisations and their rights, there are immense possibilities for speed increase. Road services for passengers and light goods run at, say, 25 miles an hour average. If the road vehicles were enabled to make use of a flat surface along the private tracks of the railways, it is certain that this average speed could be increased by fifty to one hundred per cent. It is equally certain that a body which could offer so fast a service would secure the bulk of the traffic.

Rails are probably essential for heavy goods traffic, since the tractive effort of a steel tyre on a rail is considerably less than that of a pneumatic tyre on a road. Here then is a technical problem —how to run rail and road vehicles on the same track—which, if it could be solved and carried into effect, would remove most of the difficulties now besetting road and rail traffic and effect an enormous saving to the country.

There are many less revolutionary technical problems awaiting solution. Goods are handled in most forms of transport by methods which would be considered primitive in a modern factory. Railway travelling remains dirty because a locomotive of some hundred horse power emits as much smoke as a power station of as many tens of thousands of horse power. There is more vibration and noise in a railway coach running on its smooth rail than in a road coach on a rougher road. It may be this vibration that requires a railway coach without power unit to weigh more per passenger than a road coach with power unit.

Road transport, too, has its technical problems awaiting solution. The technical development of the vehicle itself is in the best possible hands—the enterprising hands of every interested citizen. The road is in the less enterprising hands of 'authorities'. Fortunately, the Ministry of Transport came into being and acquired some, though insufficient, powers over the roads. It realised the need for technical research. In the earlier days of motor-cars, the dust nuisance was becoming intolerable. That problem has been solved. In later days, a road surface that in certain weather conditions became as slippery as ice was responsible for great loss of life. That problem, too, has been solved in great measure. The results of the Ministry of Transport's research on the slipperiness of road surfaces can be seen in the reports of 1931 and 1932 of the Technical Advisory Committee. These reports show also the large amount of work done on the resistance of different road materials and constructions to wear and impact. The value of such work can be appreciated from the fact that an increase of 10 per cent in the life of a road means a saving of some £5,000,000 a year. It would seem to be a good investment to spend on such research as much as could be spent efficiently.

This work, so ably done by the Ministry of Transport, is, however, 'a drop in the ocean' remaining to be done. Mr. O'Gorman gives a long list of matters needing investigation. Perhaps the problem needing solution most urgently is how to reduce the toll of accidents on the roads. Mr. J. Edwin Holmstrom, in the *Fortnightly Review*, has evaluated the cost of these accidents—a factor less obvious than the distress they cause. Putting the value of a fatal accident at £4,000 and of an injury at £40, the annual cost is £33,000,000.

At the end of last year the *Times* published a large number of letters on road accidents. Many remedies were suggested, chiefly the much-discussed ones by speed limit, driving test and compulsory stops at cross-roads. Nothing could show more clearly than does this series of letters, how hopeless it is to find a remedy in the present state of ignorance. The very meagre statistics of accidents now available indicate that no one, two or three of the remedies suggested would have any marked effect in reducing the number of accidents. Those who have studied the problem seldom suggest a remedy; they know that the facts are insufficient to warrant any suggestions of value. In this, as in all scientific work, observation and measurement must precede theory.

The Royal Commission on Transport, in its first report, recommended that the Ministry of

Transport should compile comprehensive statistics of the cause of all road accidents. This was in July 1929. It has taken three and a half years for the Ministry to reach the decision to carry out this recommendation, and even now it will be done only partially. From the beginning of the present year a new system of statistical records of fatal accidents was started, and the analysis of the data, if they are full enough, should point the way towards a solution of this problem.

Mr. O'Gorman advocates a Committee of Scientific Research on Traffic Control and Road Layout. The scope seems too narrow. The real problem is, what is the best way of transporting people and goods from place to place, making use of all the country's transport assets—railways, roads, canals and sea. The industry is immense; at a very rough estimate, £600,000,000 a year is spent in transport, and there is no guide to show whether this is being spent wisely. This, above all other industries, needs a Transport Research Board in the Department of Scientific and Industrial Research, a Board that will investigate transport solely from a technical point of view. It may not always be the best policy to adopt the course that is best technically, but those responsible for policy can never form a right judgment without knowledge of what is right technically.

Physics and Philosophy

The New Background of Science. By Sir James Jeans. Pp. viii+303. (Cambridge: At the University Press, 1933.) 7*s*. 6*d*. net.

EVERY year the methods of theoretical physics become more abstract and more complicated. There are two quite different reasons why this subject is so difficult to understand and discuss. On one hand, the use of concepts, which have appeared self-evident since man first began to endeavour to form a picture of Nature, has had to be abandoned. On the other, unusual and indeed sometimes completely new forms of mathematics have had to be introduced to cope with the image of the world which has been adopted. Whilst it is given to very few to possess a complete familiarity with tensors and matrices, most scientific workers and some philosophers are entitled to claim a right to discuss the fundamental concepts in terms of which the new picture of the world is drawn. Any work, therefore, which makes the new processes and concepts intelligible to the layman, is assured of a hearty welcome.

Sir James Jeans possesses in a unique degree the art of translating the most difficult and complicated forms of mathematical reasoning into an everyday language that the experimentalist and even the layman can comprehend. If for no other reason than that he has in his most recent book described the state of present-day physical theory, in terms which everybody can understand, he has put those who are interested in modern science in his debt. It is no small achievement to have given in 300 pages an explanation intelligible to the average educated reader, not only of relativity and the cosmical problem, the quantum mechanics and the wave mechanics, but also of the philosophical background which these lines of development imply.

It seems strange to-day to remember with what complacency the Victorian physicist accepted the somewhat naïve concepts such as space and time, mass and energy, which form the alphabet of his description of Nature. The triumphs of machinery which marked the nineteenth century perhaps account for his confident assumption that it must be possible to construct a mechanistic picture of the world. To-day all this is changed; a much more mystical atmosphere is fashionable. Space and time, jointly and severally, are on their trial; particles and waves are no longer obvious concepts but the cloaks of matrices and ψ functions: the very question of the possibility of constructing an intelligible model of the physical universe is at issue.

Nowhere can the change which has come over the outlook of the average man of science be better studied than in the pages of Sir James Jeans's book. How far we have travelled in twenty years is shown by the readiness with which propositions such as the impossibility of splitting uniquely into a spatial and a temporal aspect the interval between two events, or the advantage of representing a Newtonian force acting in a Euclidean void by a forceless non-Euclidean manifold, are now accepted—propositions which shocked the metaphysical conscience to its depths when Einstein first put them forward. The first half of Sir James's book is concerned chiefly with these constituents of the new background of science and, as might be expected, they are presented in a manner so lucid and conciliatory as to be almost irresistible.

The second half is concerned mainly with the quantum theory. From a most delightful introduction to the concept of a matrix, we proceed to

an explanation of Heisenberg's relation. This is succeeded by an admirably clear exposition of the wave mechanics and the more general problems of causality and determinism. No attempt is made to gloss over the lack of rigour in the derivations. Indeed one of the most attractive and valuable aspects of the book is that it makes perfectly plain how sketchy are the relations of quantum mechanics to classical mechanics and how the final formulæ can only be justified by their results. The elucidation of the wave picture as representing the state of our knowledge, and the spreading of the wave as denoting the increasing uncertainty of an extrapolation from inaccurate data as time goes on, will probably prove helpful to many. The clear demonstration, again, that what would formerly have been called the intensity of the radiation in electromagnetic waves, can only represent the probability of a photon being found at a particular point, must prove most valuable to an understanding of the Schrödinger wave mechanics. On the other hand, the use of the term "waves of probability", with its implication that there is such a thing as a negative probability, would perhaps better have been avoided.

Some further explanation also would seem to be required of the so-called *experimentum crucis* to enable us to decide between the particle picture and the wave picture (p. 252). Sir James would seem to suggest that the Stern-Gerlach experiment, which showed that a beam of silver atoms was split up in an inhomogeneous magnetic field, was incompatible with the Bohr-Sommerfeld picture. Surely the particle picture, with its definite orientation of the atomic magnets, explains this particular experimental result just as well as the wave picture. It is quite true that difficulties arise in certain cases when one endeavours to explain according to the Bohr-Sommerfeld theory the effect of a magnetic field on spectral lines, as in the anomalous Zeemann effect, but it is difficult to admit that the simple Stern-Gerlach effect is evidence either for the wave picture or the particle picture. In any event, the upholders of the wave picture are always compelled, in the final interpretation, to revert to particles; indeed, Sir James himself indicates that the wave-equation only represents a mathematical method of predicting, given certain premises, the probability that we shall find a particle.

Perhaps if Sir James Jeans had gone one step further in his analysis of our primary indefinables, the reason for this dual mode of description would have become clearer. He adopts the point of view, it is true, that there is no inherent reason why reality should be describable in terms of space and time, indeed he proves that it is not. He does not, however, attack the question whether space and time are reasonable fundamental indefinables. To the reviewer it would seem that they are concepts derived from the empirical possibility of making observations. But an observation implies a transfer of action, that is, an interference with the conjugated co-ordinate of that which one is measuring. If the transfer of action could be made in principle as small as one liked, then it would be justifiable to neglect the effect on the conjugated co-ordinate and accept space and time as independent primary indefinables. But Planck has shown us that action is atomic; this being so, space and time can only be expected to be adequate indefinables when we are dealing with large transfers of action, in which case its atomic nature is unimportant. When this condition is not fulfilled, the neglected effect on the conjugated co-ordinate must be taken into account.

However, we have no right to discuss what might have been written: our task is to consider what has been written. Here the verdict is clear. As a broad outline of the most recent developments of theoretical physics and their underlying philosophical implications, this book is unrivalled. It can be recommended with equal confidence to the physicist, the philosopher and the layman. All of them will find it helpful and stimulating. The old *Weltanschauung* of classical physics is dead. All who are interested in science must face a voyage to a new mental continent. No safer or pleasanter guide into the new regions of thought which are opening up before us can be found than Sir James Jeans. F. A. L.

Evisceration and Heart Burial

Heart Burial. By Charles Angell Bradford. Pp. 256. (London: George Allen and Unwin, Ltd., 1933.) 8*s*. 6*d*. net.

IN "Heart Burial" Mr. Bradford has collected and annotated in chronological order all the cases of burial of the heart apart from the rest of the body, which have been recorded in the London area, with the view of throwing light on this remarkable practice. The cases with which he deals range in date from the twelfth century to the twentieth, the latest being that of Thomas

Hardy, whose body was buried in Westminster Abbey and his heart in Dorset in 1928.

Mr. Bradford precedes his record of cases with a study of the practice generally. The first authenticated case is that of Robert d'Abrissel, founder of the order of Fontevrault, who died in 1117. After that date, burial of the heart apart from the body became frequent. It was usually deposited in some locality with which the deceased had been closely associated. Often those who had undertaken or desired to take part in a crusade, but had been prevented, directed that their heart should be buried in the Holy Land. Of this, Robert the Bruce is an oft-quoted example.

The practice has been connected with the customs of the ancient Egyptians, a view in which Mr. Bradford concurs. In preparing the body for embalming, the Egyptians removed the viscera and stored them in canopic jars which were placed in the tomb with the mummy. This was a ritual practice dependent on the view of what happened to the body after death. The practice persisted until the days of the Roman Empire. Division of the body for purpose of burial was banned by the early Christian Church; but it appeared again when burial within the walls of churches became common. For reasons clearly hygienic, the internal organs were removed before burial; but the heart did not at that time receive separate treatment.

The evidence upon which it is sought to connect heart burial with the Egyptian practice is tenuous and not convincing. As in much anthropological argument for cultural connexion, similarity is construed as identity, possibility interpreted as proved fact. But even if it were shown that the physical operations were connected, in idea the Egyptian and the Christian practices are poles apart; while the relatively late date at which heart burial appears is an argument against tracing it to the Egyptian custom. Between the decay of the Egyptian practice of embalming and the growth of the Christian practice of evisceration, there had intervened Christian dogma, which changed fundamentally the conception of what happened to the body after death. It was no longer desired to ensure the preservation of the body; it was regarded as something corruptible to be exchanged for the body incorruptible.

Further, the practice was not widely distributed or prevalent among the general body of the Church, as would be expected had it been a survival or a recrudescence of a pagan practice. It was confined to persons of importance or to royalty. In early Christian and medieval times, a lengthy period, sometimes a matter of months, elapsed between the death and burial of prominent members of the Church or laity. Often the body had to be conveyed long distances, as happened in the funeral of Eleanor, queen of Edward I. It is evident from frequent references in accounts of the obsequies of royalty and persons of importance, that evisceration was a practical measure of precaution against the effects of the gases of decomposition. Normally the extracted parts would be buried at once and on the spot, while the body was conveyed to its last resting place or lay in state. The parts separately buried received ceremonial treatment according to circumstance; and the separate burial of the heart was an elaboration, which sentiment in the long run made inevitable.

The Cathode Ray Oscillograph

Department of Scientific and Industrial Research. *Applications of the Cathode Ray Oscillograph in Radio Research.* By R. A. Watson Watt, J. F. Herd and L. H. Bainbridge-Bell. Pp. xvi+290+17 plates. (London: H.M. Stationery Office, 1933.) 10*s*. net.

THE outstanding advantages of the cathode ray oscillograph over any form of electromechanical oscillograph, namely uniform response to all frequencies up to at least 10^7 cycles/sec., and the convenience of direct visual observation, have been known for some time. It is perhaps not generally realised that the disadvantages which have been associated with it—high cost, short life, and insufficient brilliancy of the fluorescent screen for the photography of any but the slowest transients—have in the last year or two been largely eliminated.

This has been due in no small measure to the encouragement of manufacturers by the authors of this book, through the Radio Research Board. The result is that an instrument "of the same general standard of robustness as the familiar receiving triode", with a life under average conditions of some 500–1,000 hours, is available for the reasonable sum of £5 to £10, according to the make and type. With one well-known type, using an accelerating potential of 1,200 volts, direct photography of a single trace on the screen is possible up to a writing speed of about 20 km./sec.

The present work is practically a textbook on the use of the cathode ray oscillograph, and although all the applications described are to radio problems, many of the numerous ideas and circuits are immediately useful, or can easily be adapted, in connexion with any other work of an electrical nature. For this reason the book can be recommended to all users and potential users of the oscillograph.

The methods of using the instrument fall into two main classes: the observation of the wave-form of an unknown varying potential, and the comparison of the amplitudes and phases of two alternating potentials of the same frequency. The greater part of the book is taken up with describing circuits and typical applications for these two methods. The first method involves the provision of an electrical time-base to be applied usually to one pair of deflecting plates. Various methods of generating a saw-tooth wave-form for the production of a linear time-base are described, together with means for synchronising the time-base to the unknown potential, if this is periodic. A point with regard to nomenclature arises here. One of the commonest linear time-base circuits is the squegger or ticking-grid oscillator. Both these names are unsatisfactory, so the authors have called it the 'linotime' circuit. Such a term, however, is surely appropriate to all linear time-base circuits, including 'flashing neon lamp' and thyratron types, and would have more justification if used in this way. As for the squegger, perhaps a better name is 'blocking oscillator', which does give some suggestion of its mode of operation.

The chief applications of this method of analysis are to the observation of the wave-form of atmospherics and to the reception of echoes from the ionosphere from a transmitter sending out short pulses of radio-frequency. In this connexion a slight mistake recurs through pages 118–119, where the equivalent height of the reflecting layer is confused with the equivalent path difference, involving a factor of 2 (vertical incidence is considered).

The second method of using the oscillograph requires two exactly similar amplifiers, in order to amplify the two original potentials to a magnitude sufficient to produce a reasonable size of pattern on the screen. The amplifiers must each provide exactly the same gain and phase shift for every frequency within the band to be accepted, and various designs for such apparatus and the methods employed in lining up the two sets are described in detail. This technique was originally developed for studying the directions of arrival of individual atmospherics, but it is equally valuable for ordinary direction-finding, with the possibility of two interesting developments as suggested in later chapters—the use of radio beacons sending out very short signals, say 0·5 millisecond, so that night errors are eliminated by utilising the ground ray only for the observations, and also so that a large number of beacons may operate on the same frequency without interference; and the use of a simple cathode ray direction finder of limited range and compact construction to act as a collision preventer on ships.

An important utilisation of the direction-finding technique is its application to the analysis of the state of polarisation of wireless waves, both continuous wave and pulse transmissions, reflected from the ionosphere. It has also been applied to two spaced aerials, in order to determine the angle of incidence of downcoming rays.

A number of interesting applications of the oscillograph as a relay are described which depend on the introduction into its envelope, near a suitable point on the screen, of a small Faraday cylinder to act as a collector when the beam is directed on to it. A chapter or two on photographic technique and suitable cameras will be found useful. To save repetition, a glossary of a number of technical terms is included. Of these, 'to common' seems rather unnecessary; 'join', or 'connect together', cover most of its uses.

Palæontology of the Lower Vertebrates

Text-Book of Palæontology. By Prof. Karl A. von Zittel. Translated and edited by Dr. Charles R. Eastman. Vol. 2. Second English edition, revised, with Additions, by Sir Arthur Smith Woodward. Pp. xvii+464. (London: Macmillan and Co., Ltd., 1932.) 30*s*. net.

THIRTY years have elapsed since the appearance of the previous edition of this work, and the task of revision has, in consequence, been considerable. No one better qualified to shoulder this burden than Sir Arthur Smith Woodward could have been selected, for, in addition to being one of the six original authors concerned in the production of the earlier edition, he has had unrivalled opportunities for keeping in close touch with every advance made in this branch of science during this interval. In producing this volume he

has placed every student of the lower vertebrates under a deep obligation.

The present edition is half as large again as the original. Apart from this fact, it appears at first sight to be unchanged, for the general arrangement and method of treatment of the text, and the relative proportion of figures, are the same. Nevertheless, a large quantity of carefully selected new material, summarising recent work, has been incorporated. Concise analyses of the extensive new literature upon such groups as the Ostracodermi, the Stegocephalia, and the reptiles of the Permian and Trias, form most useful acquisitions. On the other hand, much of the old material, which has been brought forward from the former edition, has been recast or even completely rewritten.

A textbook of this type is, of course, concerned more with the orderly presentation of facts than with theoretical discussion of them. In so far as an approach to a general consensus of opinion upon the latter has been reached, it will be found here crystallised in the form of a system of classification. On this account, some of the most fascinating pages in the book are to be found in the table of contents, which has been extended from two to ten pages. A comparison of the tables of contents in the two editions will reveal changes just as striking as the somersault experienced by the figures of *Birkenia* and *Lasanius* (p. 53 in the old edition, pp. 23 and 24 in the new).

The value of the work has been greatly enhanced by the insertion of one hundred and sixty new figures. The traditional practice of using figures of the actual fossils has been maintained, but care has been taken to improve the quality of these by selecting examples in which the original specimen was sufficiently clear to be understood even by an inexpert student. Some of these figures, for example, that of *Helicoprion* (p. 64) add considerably to the attractiveness of the book. The reviser has, however, wisely made a much more extended use of reconstructions of the whole or parts of skeletons.

One minor criticism of this excellent revision may be offered. The method of presenting the bibliography which has been adopted causes unnecessary difficulty and loss of time when, as so often happens, a specific reference is wanted.

H. H. S.

Short Reviews

Irrigation Principles and Practices. By Prof. Orson W. Israelsen. (Wiley Agricultural Engineering Series.) Pp. xiv+422+8 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 31*s.* net.

THE practice of irrigation is so widespread in all parts of the world, there being more than 200 million acres of land artificially treated with supplies of water in the five continents, that it is a little surprising to find in a book dealing with the subject of irrigation under a general title, without qualification of any kind, a complete absence of reference (apart from a few photographs of primitive appliances in Oriental countries) to processes and methods other than those to be found in a group of some seven or eight of the United States lying to the west of long. 100° W. and embracing an area of about twenty million acres under treatment; say, a tenth part of the whole. While this localisation detracts somewhat from the serviceability of the book to the general reader, it does not, of course, invalidate it as a useful compendium of information on methods of irrigation in that particular region and, indeed, within its purview, it is an admirable guide.

The author is professor of irrigation and drainage in Utah State Agricultural College and he writes for the benefit of college and university students who seek information on the agricultural aspects of irrigation, though the book also surveys other aspects in a minor degree: engineering, social, arboricultural, etc. Following an explanation of general principles, including theoretical considerations of the flow of water, systems of supply and measurement, soil and water relations, the underground movement of water and kindred matters, the book discusses in detail the irrigation of cereals, of alfalfa, of sugar beet and potatoes, and of orchards. The treatment is clear and attractive and the illustrations are good. A set of problems and questions with numerical answers forms a useful appendix. B. C.

(1) *Wireless Receivers: the Principles of their Design.* By C. W. Oatley. (Methuen's Monographs on Physical Subjects.) Pp. vii+103. (London: Methuen and Co., Ltd., 1932.) 2*s.* 6*d.* net.

(2) *Testing Radio Sets.* By J. H. Reyner. Second and revised edition. Pp. viii+207+8 plates. (London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

(1) Mr. Oatley's monograph is a model of compression, and may be commended as a worthy member of a valuable series. It gives thoroughly dependable analyses of the essential circuits of the receiver, chapters being devoted to the triode and

its equivalent circuit, the aerial-earth system, high-frequency amplification, the detector stage, low-frequency amplification and the power stage. A bibliography of some fifty items is appended. The book would have been very good value at a price well above the modest sum asked for it.

(2) Mr. Reyner's second edition is a marked improvement on the original edition, but it is marred by an unnecessary diffuseness, a tendency to repetition, some looseness in expression and explanation, and very uneven allocation of space between major and minor problems. The present state of 'service' arrangements for broadcast receivers in Great Britain is, however, with a few gratifying exceptions, so bad that a book of this kind will continue to be necessary and useful until the average level of intelligence in 'service' work has been raised substantially above its present value.

Grundriss der Mineralparagenese. Von Prof. Dr. Franz Angel und Prof. Dr. Rudolf Scharizer. Pp. xii+293. (Wien und Berlin: Julius Springer, 1932.) 19.80 gold marks.

THE study of mineral paragenesis is of comparatively recent date and a comprehensive work on this subject is to be welcomed. The present authors have succeeded in bringing together a great mass of important data much of which has been derived from scattered and inaccessible sources.

The book is divided into four sections. The first is devoted to a general discussion of organic and inorganic substances and to the structure and composition of the earth as a whole. In the three succeeding sections the rock-forming minerals and their genesis, the minerals of ore deposits and finally the materials of the biosphere are treated in detail. In all cases the genetical aspect is stressed and also the typical associates of each individual species. Wherever possible the authors have employed the modern constitutional formulæ.

It is unfortunate that it has not been found possible to give references to the publications of the various authorities quoted, for a comprehensive bibliography would have greatly increased the value of the book. Nevertheless, it fills a hitherto vacant place in mineralogical and petrographic literature and can be recommended both to the mineralogist and petrologist. Readers must beware of occasional errors in geographical localities.

Collected Geometrical Papers of Prof. Syamadas Mukhopadhyaya. Part 2. Pp. vi+159–295. (Calcutta: Calcutta University Press, 1931.) 3.8 rupees.

THIS volume is a continuation of the volume of papers by the same author published in 1929 and reviewed in NATURE of April 4, 1931, p. 516. There are two papers on plane convex ovals, but the chief part of the book consists of seven papers on the differential geometry of curves in an N-space. The latter are of special interest both on account of the original methods employed and the results obtained. They deal with parametric coefficients and their properties, the extension of the Serret-Frenet formulæ to curves in the N-space, the expression of the co-ordinates in terms of the arc, curvatures at a singular point and osculating spherics. Unfortunately, the investigation is restricted to Euclidean space, but the author claims that, by the use of a certain distance formula, it can be adapted to any kind of non-Euclidean space without insurmountable difficulties. It would be of some interest if such a programme were actually carried out, if only for the four- and five-dimensional spaces used in relativity theory. The abstract nature of the topics dealt with makes the papers difficult to read, but students of algebraic geometry should find much to interest them. The book is clearly printed and unusually free from misprints, and is a credit to the Calcutta University Press.

Everybody's Dog Book. By Major A. J. Dawson. Second edition. Pp. viii+231+31 plates. (London: Philip Allan and Co., Ltd., 1933.) 5*s.* net.

THIS book has passed through five impressions and is now in its second edition since its first publication in 1922. The chief feature of the book is that it is written by a man who is clearly very familiar, in a practical way, with his subject, and is a lover of dogs. The care and cultivation, feeding, breeding, treatment and showing of dogs, take up the major portion of the volume. A list of dog societies is appended. The whole work is very practical and therefore very useful to dog lovers and breeders. The scientific aspect is stressed; for example, the recently published results of the ten years' activity of the *Field* Distemper Council are included.

Several excellent photographs of breeds of dogs now in favour add to the attractiveness of a really good book.

The Flora of the Clyde Area: a Handbook of the Flowering Plants and Ferns occurring Wild or Established within the Drainage Area of the River and Firth of Clyde. By John R. Lee. Pp. xvi+391. (Glasgow: John Smith and Son (Glasgow), Ltd., 1933.) 7*s.* 6*d.* net.

NATURALLY this book will have a rather limited appeal, since it deals only with the flowering plants and ferns occurring wild or established within the drainage area of the River and Firth of Clyde. However, it is more than forty years since the late Prof. King's revision of Hennedy's "Clydesdale Flora" was published and all editions of it are now out of print, so the present work will be welcome. Botanists interested in this area are indeed fortunate since they now have available a well-compiled flora of the district. The author has obviously taken meticulous care over his task and has spared no pains in his endeavour to be up to date and authoritative. It is a pity that more local floras, of this standard, are not available.

Nitrogen and Plant Nutrition

IN his discourse on "The Nitrogen Hunger of the World" at the Royal Institution on March 31, Sir Frederick Keeble first retold the tale of the transmigration of nitrogen from atmosphere to soil, from soil to plant and animal, and from these back to the air. The fixation of atmospheric nitrogen by the thunderstorm and certain bacteria has of late been supplemented by the chemist, and we now have to contemplate "a new world wherein never more need the gaunt spectre of famine stalk the earth, and where health shall be the rule and disease the rare exception: the world of nitrogen plenty". The earth is hungering for nitrogen. An acre of English meadowland produces on an average about a ton of hay; a nitrogen fertiliser, together with minerals and adequate water, will increase this yield from two-fold to nine-fold. The productiveness of the sea, as well as that of land and fresh waters, is limited by nitrogen insufficiency, for how else can we explain the fact that tropical seas support less life than temperate seas?

The expedients used by green plants to obtain nitrogen are well-nigh endless; some become saprophytes, others parasites. All parasitism, both of plants and animals, appears to be the result of nitrogen hunger. Life depends on the resultant of the two opposing forces: the bacteria that fix nitrogen and those that liberate it or hoard it; and in the earth's history sometimes one and sometimes the other may have prevailed. When the nitrogen-fixers prevailed, "life burgeoned forth in exuberance and beauty"; but when nitrogen accumulated in the atmosphere, fertility declined. Perhaps every geological epoch has seen these changes. A new land arising from the sea is rich in limestone, phosphates and other minerals, but it remains barren until nitrogen-fixing bacteria borne by wind or water are sown over it and their growth is favoured by the abundance of phosphates.

The earth yields more and more plentifully, but as the centuries pass, rain and wind wash away and blow away the minerals, and even the soil itself. The phosphates, no less essential to life than nitrogen, begin to fail, and with them the nitrogen-fixing bacteria. Life declines, vegetation shrinks in size and amount; the green herbage which formerly protected the earth wears thin; rain rends the soil and animals make the rents wider by over-grazing, until at last the land becomes a desert. Something like this has probably occurred on the South African veldts, the desert nature of which is commonly supposed to be due to lack of rain. That explanation, however, is inadequate; it is lack of nitrogen and minerals which aggravates the ill-effects of low rainfall and causes such rain as falls to run to waste and to carry with it the valuable minerals. The veldt responds immediately to nitrogen fertiliser, and nitrogen may well prove to be the salvation of South Africa.

The effects of nitrogen starvation are no less apparent in Great Britain, especially on grasslands in springtime, where the early application of a nitrogenous fertiliser may enable cattle to graze weeks before they can graze on untreated land. This power of nitrogen to produce an 'early bite' may save British farmers at least the £500,000 a year that they now expend on artificial feeding-stuffs; and it presents a new point of view for the study of soil fertility. Pasture grass, treated with nitrogen, begins to grow vigorously when the temperature rises to 42°–43° F., whereas ordinary grass does not. This failure to grow is not due to absence of nitrogen, for the humus of pasture-land contains plenty: it is due to the nitrogen being locked up by bacteria in an unavailable form. Addition of an anæsthetic to grassland containing added nitrogen to which it has not responded at once makes the nitrogen available, and the grass grows.

Grass does not grow on natural pastures in early spring, even when the temperature is favourable, because the necessary nitrogen-building materials are lacking; but grass that has been treated betimes with available nitrogen starts early growth because the roots begin to absorb it at temperatures below which growth of leaf and stem does not occur, and they not only absorb it but also elaborate it into the complex organic compounds which leaf and stem require for growth. In arable soils also, nitrogen gets locked up at low temperatures; and crops like potatoes profit by the presence in the soil of available nitrogen in addition to that of farmyard manure. The reason why the addition of a nitrogenous fertiliser to a soil already rich in humus-nitrogen often leads to an increased crop, is now self-evident.

Drought may also cause the soil to withhold the nitrogen that plants need. After a dry spell, grass that has been manured with available nitrogen grows more quickly than grass that has not been so manured; and it is not surprising that, during drought, soil bacteria beat the green plant in competition for nitrogen. The green plant is of aquatic origin and acknowledges its ancestry by its dependence on large and constant supplies of water. Soil bacteria, minute and chitinous-coated, can sustain drought better than the green plant and so can defeat it when rainfall is scanty. Grass which has been treated to provide an 'early bite' does not suffer later if the dressings of plant-food are continued at regular intervals.

Apple trees usually bear large crops in alternate years; in the years of plenty large supplies of nitrogen are required for the fruits, the leaves have to go short and remain small, so that they do little work in providing food for next year's crop. Hence the next year's crop is small; but if nitrogen be given in early spring before flowering, the roots absorb it and the tree works it up into plant-building material, and there is plenty for

flowers, fruit and leaves. So the 'off' year disappears.

Fertility is also closely connected with the variety of crop plant cultivated. Wheat is commonly supposed to resent much nitrogen, and if heavily manured it 'lodges'. This is true of some of the wheat varieties grown in England, for example, Squarehead Master, but not of others, such as Chevalier, and if such varieties were grown more generally and amply manured, the average yield of wheat, high as it already is, could be made to equal the yields obtained, for example, in Holland.

Apart from the power of nitrogen to give increased yields, at a low cost, the use of it, and that of mineral plant foods, is essential for producing the kinds of food that will maintain and improve the health of man. Recent experiments tend to show that a moderate use of these materials doubles the yield of protein from grass, and that this increase is attended by a corresponding increase in carotene, the precursor of vitamin A. Nitrogen-treated grass that has been dried by artificial heat has been found a perfect substitute for a large part of the concentrated food (now imported) that is usually fed to stock in winter, and the butter made from the milk of cows fed on this grass is far richer in carotene than that made from the milk of cows fed on the ordinary winter ration ; it has the deep primrose-yellow colour characteristic of the best dairy butter (see *Emp. J. Exper. Agr.*, 1, 68 ; 1933).

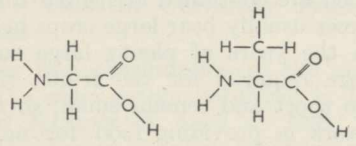
There is much more yet to be learned of the parts played by vitamins and minerals in nutrition. Pasture-land appears to require but very little lime ; probably because much of it returns to the soil when the grass dies. Although 'nitrogen grass' contains less lime than ordinary grass, the milk yielded by cows that eat it is the richer in lime. This suggests that the lime in the green plant may exist in either a metabolic state, in which it can be handed on from the grass through the cow to the milk, or in an inert state, in which it can be handed on less surely. Similar possibilities are attached to other elements, of which silicon may prove to be one. The lack of carotene in ordinary winter butter suggests that influenza and yet graver maladies may be prevented by supplying food lacking none of the essential vitamins and minerals. Tuberculosis, both human and bovine, may prove to be a deficiency disease which is encouraged by the lack of vitamins. At any rate, it seems certain that an ampler provision of vitamins in the milk, butter, cheese, eggs and vegetables consumed by the people in winter is an essential step in improving national health. There are numerous examples in the plant world of diseases due to deficiencies, such as of potash in apple trees, of sulphur in the tea plant, of magnesium in fruit trees, and of iron, manganese, boron and copper in other crops. In fact, one might almost say that imperfect nutrition is responsible for all disease.

If there is any truth in the conjecture that in the past the earth has passed through alternate phases of nitrogen plenty and nitrogen scarcity, a new and revealing light may be thrown on evolution. The path of evolution is strewn with its victims, but it is also illuminated by all the beauty of animate things. Is all this beauty only a casual by-product, or is it an enduring memento of the times when the earth was endowed lavishly with nitrogen ? Nature unaided contrives here and there oases of plenty in a world of want, and beauty is born there. Man can make, if he will, the whole world an oasis where want is unknown and beauty reigns supreme.

Crystals of the Living Body*

By SIR WILLIAM BRAGG, O.M., K.B.E., F.R.S.

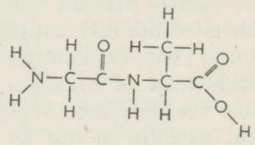
IT has continually happened during the recent development of X-ray analysis that its first results have been confirmations of the conclusions of the organic chemist, and have been followed immediately by closer definitions and fuller knowledge. The chief feature of the structure of proteins has been supposed, on chemical grounds, to be a chain-like arrangement of amino-acids. These bodies may be obtained in the laboratory by breaking up



Glycine. Alanine.

the natural proteins. There are many kinds of them, and they can be separated and examined in detail. Two of the simplest are glycine and alanine.

They are characterised by the presence of an amino-group, NH_2, on one side of a certain carbon atom and of a carboxyl group, COOH, on the other. One has a positive character, the other a negative : the two groups have not only a general attraction for one another, but can also be made to combine in the manner shown below :



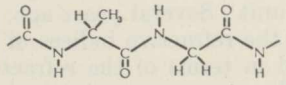
Glycine and Alanine.

Two hydrogen atoms and one oxygen have dropped out. Willstätter supposed that such combinations could take place in regular alternations

*Continued from page 13.

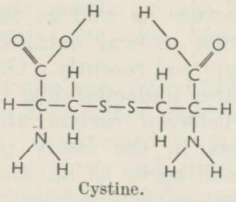
of the two amino-acids, thus forming a chain of indefinite length.

Now alanine and glycine can be obtained from the decomposition of natural silk. If this regular structure is the cause of the X-ray photograph of silk, the numerical details that can be obtained from an examination of the photograph must fit in with the structure proposed by the chemist. This is remarkably verified. Previous X-ray work has shown that a chain composed of two carbons and one nitrogen in regular succession would probably take the zig-zag form well known as a characteristic of long chain compounds. The following formula shows how the silk protein would be represented.



From the X-ray analysis of many organic compounds, we have learnt the dimensions of the atoms of carbon and nitrogen, and we can assert that the distance along the chain at which the pattern (two carbons and one nitrogen) repeats itself should be about 3·6 A. Now the interpretation of the X-ray picture, though hazy in some respects, is exceedingly precise in one at least. It shows that some arrangement exists along the fibre, based on a pattern which repeats itself at intervals of 3·5. The coincidence is striking. The X-rays show not only that there is arrangement among the molecules in the silk, but also that there is agreement with chemical theory as to the existence of a repeat in each chain. They show also that the chains—this also is one of the details which can be examined in the picture—are arranged more or less parallel to one another and to the direction of the fibre. This is the sort of arrangement which we should expect.

Silk fibroin is one of the simplest of the proteins. There are innumerable other possible combinations, because there are many different amino-acids and kindred bodies which can be strung on to the chain in various ways. There is, for example, cystine, which clearly can be inserted



Cystine.

into the chain by either of its ends. This group contains the sulphur which occurs in hair.

To return now to the keratins which, as I have said, do not give the same diffraction pattern as silk and other proteins. Hair, feathers, horn and the like give photographs which are comparable with each other. Astbury has made the surprising discovery that a hair when stretched gives a picture resembling that of silk. The stretching alters the arrangement of the molecules. If the hair is allowed to resume its former length, which it readily does if the operations are carried on in warm water, the first form of picture is again obtained, so that the effect is reversible. Silk does not possess any capacity for complete recovery after extension. Hair recovers completely after 30 per cent of extension; beyond that there is only a partial recovery though it will stand an extension of 70 per cent before breaking.

Astbury has pointed out that these effects can be readily accounted for by supposing that the chain which forms the backbone of all the proteins is similar to that of silk. But in the keratins the chain is somewhat crumpled up. Tension pulls the chains straight without breaking them, so that the contractile forces, whatever they may be, can restore the chain to its old form, and the process of extension and contraction may be repeated indefinitely. Beyond the 30 per cent of elastic extension there is a possibility of further extension by means of the slipping of molecules past one

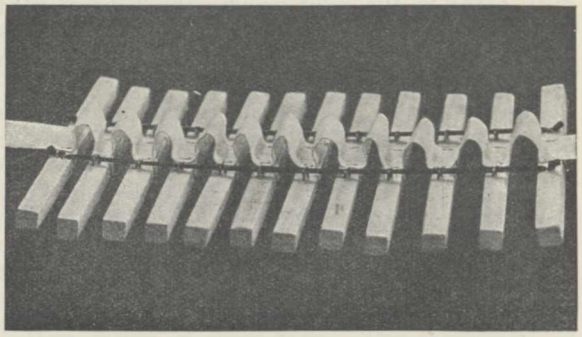


FIG. 4.

another. This is practically the only form of extension possible in silk: it is not reversible.

A comparison of the two kinds of X-ray photographs supports this conception. The distance of repeat along the chain in stretched wool is only a very little less than that of silk, which is correct if the stretching of the wool is due to the stretching of the chains, while the repeat in the unstretched hair is 30 per cent shorter than in the stretched. Other geometrical deductions from the photographs, some very definite, others less definite, are also in general agreement with the hypothesis.

But why should some keratin chains tend to crumple up while others do not? A plausible explanation can be readily given. The amino-acids and other pendants of the chain have a certain attraction for each other, at least if there are some which contain acid groups, while others have a basic character. All such attractions tend to shorten the chain.

A rough model can be made to illustrate this point by stringing a number of wooden bars along a piece of flexible material (see Fig. 4). Elastic threads join the ends of the bars as shown and tend to draw them together. The attractions simulated by the elastic links tend to shorten the

chain, but an applied tension may break the connexions so formed and give the chain its full length. This sort of thing cannot be expected to happen in the case of silk, because glycine and alanine have no attraction for each other, built as they are into the chain.

The same hypothesis gives a good explanation of the fact that hair and other keratin structures are so very resistant to chemical actions such as the attacks of enzymes. The crumpled chain protects itself in several ways. Its susceptible points are masked, partly by its compactness, partly by the previous satisfaction of tendencies to combination either in respect to groups belonging to the same chain or to different chains. Thus hair, horn and similar materials acquire a peculiar permanency often illustrated by the state of the remains in ancient tombs.

All these facts are illustrative of the statement with which I began, namely, that not only does the arrangement of the atoms in the molecule decide the characteristics of the molecule but also the arrangement of the molecules with respect to each other in the solid decides the behaviour of the solid. Arrangement of the protein molecules among themselves is essential to their function in the living body.

These general deductions regarding protein structure are only an earnest of what may be expected to follow from the precise measurements of position which we are now able to make. They are no more than indications of the directions in which knowledge of living structure may be able to advance as a consequence of the new methods of inquiry. Like any other new tool, X-ray analysis has to be in use for a certain time before its capacities are understood.

Besides the direct applications of X-rays which I have been describing, there are certain other ways in which the substances of the living body have been studied by their aid. A most interesting example is the examination by J. D. Bernal and his colleagues of the crystal structure of the separate amino-acids, of the vitamins and similar bodies. When such bodies can be crystallised, valuable hints can be obtained as to the arrangement of the atoms and molecules, even if the structure cannot be fully determined. Chemical considerations suggest various possible arrangements, the choice from which may be narrowed down by the result of X-ray measurement. Thus, for example, Bernal showed that the formula proposed for sterol must be incorrect: in consequence, a search for the proper formula was instituted and has seemingly been successful.

Bernal's investigations of the structure of these compounds are an example of one of the two lines along which, broadly speaking, X-ray work is advancing. A series of like compounds is examined, and the various members are compared with each other. Information is derived from observations of the changes as the composition is varied step by step. In this particular research some twenty different substances have been compared. They are all members of a family of the greatest importance biologically. Their X-ray pictures show that they possess certain common characteristics of a structural nature, and the comparison of gradually changing quality with corresponding changes in certain dimensions gives important hints as to constitution.

A new method often gives new force to older methods, and this is happening now. The optical, magnetic and other constants of a crystal show remarkable dependencies on the crystalline form. When we are able, as in this case, to determine the contents of the unit of pattern, and sometimes are able to go so far as to find the position of the atoms and molecules in the unit, the constants in question can be connected directly with the contents of the unit. Several years ago, W. L. Bragg showed how the refractive indices of calcite could be calculated in terms of the refractivities of the atoms and the arrangement in the calcite crystal which had just been discovered. So also, electrical displacement takes place with much greater ease in the plane of the aromatic benzene ring than normal to it. Consequently, the velocity, within the crystal, of light in which the vibrations are perpendicular to the ring is greater than that of light in which the vibrations lie in any other direction. This principle can be used to help in the determination of the arrangement of the molecules in the crystal.

There is a second line of advance which is being followed; and the two modes of research support each other. In this other method the arrangement of the atoms in very simple crystals is worked out to the bitter end. The method is very laborious and cannot at present be applied to complicated cases. Molecules are chosen for investigation containing the atomic groupings which occur so widely, hydroxyl, carboxyl, benzene linkings and so on. Experiment shows, so far as it has gone, that the relative positions and orientations of the atoms in these common groupings are always the same or nearly so. If they are exactly determined from the examination of particular cases, the resulting rules can obviously be very helpful in the determination of structure, and also we may confidently hope, in the discovery of the *why* of a particular structure as well as the *how*.

On these lines several detailed investigations have been completed recently. One of the results has been a better understanding of the details of the linkages between carbon atoms. It is of especial interest in the study of organic compounds, and will serve as an illustration. It is well known that carbon linkages are not all the same; we speak of a single bond, a double bond, and so on. According to the measurements we are now able to make, there are at least two kinds of carbon linkage differing primarily in the closeness of approach. There is the diamond linkage in which each carbon atom is at a distance of 1·54 A. from its four neighbours: and the graphite linkage where the distance is 1·42 A. between each atom and its three close neighbours. The difference

between these is far greater than can be put down to experimental error. The former kind occurs also in the fatty acid chains, where each carbon also has four neighbours, two carbons and two hydrogens. The latter is found in anthracene and naphthalene, the basis of these substances being the benzene ring: in these the carbon has three neighbours as in graphite. It may prove to be the case that the former kind of bond is peculiar to the aromatic substances and the latter to the aliphatic. The heats of combustion of diamond and graphite are very nearly the same: so that it takes as much energy to break down the four bonds in the diamond as the three in the graphite. In such a comparison the heat spent on breaking the weak bonds between the network layers of graphite is taken to be negligible.

Such accurate measurements as these encourage the hope that there are exact rules as to distances apart of the atoms, and very probably as to their mutual orientation. Knowledge of these rules will greatly facilitate the determination of structure.

What has been said above may serve to show how eagerly the new powers of detecting molecular arrangement in the solid are being used. With the knowledge gained in this way we may learn more of the forces which bind all atoms and molecules together, and in particular consolidate and give form and function to the various constituents of the living body.

Biometric Studies of Twins

A MEMOIR with the title "A Biometric Investigation of Twins and their Brothers and Sisters", by Dr. Percy Stocks assisted by Mary N. Karn, printed in the *Annals of Eugenics* (vol. 5, Jan. 1933), forms part 2 of a paper of which part 1 was published in the same *Annals* in 1930 and was noticed in NATURE of November 15, 1930 (vol. 126, p. 766).

Part 1 dealt with the characters, height, weight, head length, head breadth, head circumference, interpupillary distance, blood pressure, pulse and respiration rates, colour of eyes and hair, degree of facial resemblance and finger prints. In the present part, the measurements of strength of grip, acuity of vision, colour vision, cutaneous sensibility and upper limit of auditory sensibility are analysed by the same technique, the mental measurements are discussed, and two special problems are also dealt with: (1) asymmetry in relation to twinning, (2) correlation between physical measurements in the same individual, and the question whether this is any different in monozygotic twins from the value found for other children. For the methods of distinguishing monozygotic twins from dizygotic twins, when the twins are of the same sex, reference must be made to the previous memoir: the decision is made partly on the basis of finger prints and partly on the basis of physical characters.

Monozygotic twins were found to have a stronger mean hand grip than other children of the same ages, as might be expected from their superior height. For dizygotic and monozygotic twins respectively the correlations between members of the pair, corrected for experimental errors and day to day fluctuations, were found to be of the order 0·4 and 0·7. The former implies resemblance to the same degree as for ordinary siblings, and the power to grip seems to be relatively dependent on inherited constitution and environmental influences in about the same proportions as in the case of blood pressure, pulse and respiration. For visual acuity, cutaneous sensibility and sensitiveness to sounds of high frequency, dizygotic twins again resemble each other to the same degree as ordinary siblings, the coefficients being of the order 0·25–0·3. For visual acuity the coefficient for monozygotic twins is higher, about 0·5; but for the other sensory tests this result is more doubtful. It is clear, however, that heredity plays some part in the development of these characters. No evidence was found for an increased tendency to symmetry-reversal in monozygotic twins, when tested either by strength of grip of the right and left hands or by acuity of vision for the right and left eyes.

The results of the mental tests are of special interest, as they have an emphatic bearing on the interpretation of these tests. The coefficients of correlation between members of the pair are about 0·85 for monozygotic twins, 0·65 or more for dizygotic twins of the same sex, and about 0·45 for siblings. As the authors state, it is difficult to account for the high degree of resemblance in dizygotic like-sexed pairs without admitting that the close association of one twin with another plays an important part in producing like responses to these tests: the responses appear to be a measure, not as is often assumed of virgin intelligence, but of intelligence and the effect of experience superposed.

Height is more highly correlated with weight and with head dimensions in monozygotic twins than in others, though for most characters there is no regular or significant difference. The authors argue that, if monozygotic twins arise by the primary division of a single fertilised ovum, it might be expected that, unless the primary division of every component of the cell occurred with exactness, there could result a lower correlation between different characters in the same individual amongst monozygotic twins than amongst the other types. But is this conclusion necessary? If two characters are determined by $a + b$ genes and $b + c$ genes respectively, the b genes being common to the two, the genetic correlation is dependent

solely on the proportion $b/\sqrt{(a+b)}\,(b+c)$, and there seems no reason why this proportion should tend to be lowered by chance fluctuations in the cell-division.

The memoir concludes with twelve pages of tables containing all the measurements taken, and the two parts together should form a classic in the growing literature of the subject.

Obituary

Dr. Sydney A. Kay

SYDNEY ALEXANDER KAY was born in Dundee in 1874 and after leaving the High School became a student at University College, Dundee, under Prof. (now Sir) James Walker. The association thus begun continued through most of Kay's life. His student career was a brilliant one —he gained the medals in chemistry, natural philosophy, mathematics and physiology. Graduating as B.Sc. in 1896, he engaged in research with Walker, and two papers—"On the so-called Magnesium Hypoiodite" (*Proc. Roy. Soc. Edin.*, 21, 236; 1896) and "Velocity of Urea Formation in Aqueous Alcohol" (*J. Chem. Soc.*, 71, 489; 1897)—recorded the investigations. The award of an 1851 Exhibition scholarship enabled him to study under Arrhenius at Stockholm and under Ostwald at Leipzig. The work done at Stockholm furnished material for a lengthy paper on "Equilibrium between Sulphuric Acid and Sulphates in Aqueous Solution" (*Proc. Roy. Soc. Edin.*, 22, 484; 1899).

The next ten years were spent at St. Andrews, where Kay proved himself a most efficient assistant to Prof. Purdie and an extraordinarily conscientious teacher. Perhaps one might say that conscientiousness was his outstanding quality. While at St. Andrews the degree of D.Sc. was conferred upon him in 1902, and three years later he became a fellow of the Chemical Society, London.

On the retirement of Prof. Purdie in 1909, Kay transferred to Edinburgh; once more to be associated with Walker, who had succeeded Crum Brown in the chair of chemistry in the previous year. He devoted himself anew to teaching and more especially the teaching of chemical analysis. The textbook—Cumming and Kay's "Quantitative Chemical Analysis"—first appeared in 1913, the fifth edition in 1928 and, at the time of his death, Kay was looking forward to a term's leave of absence to be occupied in bringing out a completely revised edition of the book. Another volume by Kay alone appeared in 1921 under the title "Qualitative Analysis of Inorganic Substances". He became much interested in water analysis and with Walker published "The Acidity and Alkalinity of Natural Waters" (*J. Soc. Chem. Ind.*, 31, 1013; 1912) and with Susan H. Newlands "Determination of the Hardness of Natural Waters and the Use of Methyl Red as an Indicator" and "The Determination of Calcium and Magnesium in Natural Waters" (*J. Soc. Chem. Ind.*, 35, 445 and 447; 1916). During the second half of the War he did good service as deputy inspector of high explosives for the south of Scotland.

Kay was appointed a lecturer in chemistry in 1914 and from 1922 gave lectures to the agriculture and forestry students and was in charge of the Advanced Inorganic Laboratory. From him, many students learned method and accuracy and the value of skilful manipulation.

Kay was a lover of Nature and his vacations were generally spent in the Highlands, where he found great happiness in the study of wild life. His skill with the camera was notable and he was at one period president of the St. Andrews Amateur Photographic Society. In 1905 he married Margaret Frazer Plenderleath. The union proved a happy one and the sympathy of his colleagues and friends goes out to her in her great bereavement. After a very brief illness Dr. Kay died on May 26, and those of us who knew him have lost a true friend.

J. E. M.

Dr. Norman U. Meldrum

THE death of Dr. Norman Urquhart Meldrum on June 7, at the early age of twenty-five years, has robbed biochemistry of an exceptionally active and brilliant young worker. A month earlier he had had a riding accident, from the effects of which he had not fully recovered. He was educated at the University of Edinburgh, where he took his B.Sc. degree in 1928. In the same year he became a member of Emmanuel College, Cambridge, and joined the Biochemical Laboratory with a grant from the Carnegie Fund. In 1930 he obtained a Beit fellowship (for medical research) which he held until his death. He took the Cambridge Ph.D. in 1931.

Immediately after the isolation of crystalline tripeptide glutathione by Hopkins in 1929, Meldrum and Dixon investigated its properties, and found that these differed unexpectedly from those of Hopkins's amorphous preparation of 1921. Until his death Meldrum continued working on the properties and functions of glutathione in the organism, but published no other large papers on the subject. He also gave some attention to other problems such as the denaturation of proteins.

After taking his doctor's degree, Meldrum joined Roughton in his investigation of the carbon dioxide catalyst present in blood. This co-operation speedily led to the isolation of a new enzyme, carbonic anhydrase, the study of which has opened up a large new field of work (see NATURE of June 17, p. 874). Meldrum's biochemical knowledge was of the greatest value in this research.

Meldrum had a real genius for getting to the heart of a biochemical problem and it was this,

together with his great energy, which enabled him to accomplish so much in so short a time. He was a strong stimulus to his colleagues, and an interesting companion in other ways than merely scientific. With all his gifts and promise, he would undoubtedly have made a great name for himself in science, had not his life been cut short so early.

DR. W. C. VAN DER STERR

WE regret to announce the death, which occurred at Amsterdam on May 17, of Dr. W. C. van der Sterr. By his death the Union of South Africa has lost a prominent man of science. W. C. van der Sterr was born in Holland in 1867 and at about twenty-five years of age migrated to South Africa. His earliest work was in the Transvaal, where he and his partner, Mr. E. W. Ferguson, as private surveyors, were assigned by Government the establishment of the triangulation of control of the city of Johannesburg. At the end of the South African War he was largely instrumental in founding the Land Surveyors' Institute of the Transvaal and in starting a valuable journal in connexion with that Institute.

Now a marked man, Dr. van der Sterr was offered an official position in 1919 in the Cape Province and two years later was appointed the director of the Trigonometrical Survey of the whole Union. He thus became South Africa's foremost geodesist, following in the steps of the Abbé Lacaille, Sir Thomas Maclear and, above all, Sir David Gill.

He was successful in initiating the degree of B.Sc. in surveying at the University of Cape Town in 1928, where he was attached as reader in surveying while he continued to hold his official appointment in the Union. A year earlier the University had conferred on him an honorary D.Sc.

Dr. van der Sterr represented South Africa at various conferences in Europe, and his British colleagues have the pleasantest memories of association with him at these reunions. He set a high standard of accuracy as his ideal and has left to his successors the task of maintaining the geodetic tradition so long current in South Africa.

WE regret to announce the following deaths :—

Dr. E. E. Fournier d'Albe, inventor of the optophone and a pioneer investigator on the properties of selenium, author of a "Life of Sir William Crookes" (1925), on June 29, aged sixty-five years.

Mr. Lucien A. Legros, O.B.E., formerly president of the Institution of Automobile Engineers, known for his publications on type-casting and on traction, on June 16, aged sixty-seven years.

Mr. H. R. A. Mallock, F.R.S., consulting engineer, formerly a member of the Advisory Committee for Aeronautics and consulting engineer of the Ordnance Board, on June 26, aged eighty-two years.

Mr. Ralph Richardson, commissory clerk of Edinburgh and probate registrar for Scotland, formerly president of the Edinburgh Geological Society and secretary of the Royal Scottish Geographical Society, on June 26, aged eighty-eight years.

News and Views

Sir Henry Lyons, F.R.S.

WHEN Sir Henry retired from the Survey Department of Egypt and joined the Science Museum in 1912, assuming the directorship in 1920, he found it characteristically free from the conventional ideas of what constitutes a museum. It has been his work to extend still further its range and to adapt it to what are believed to be modern needs. While retaining its original purpose of conserving for the student and historian records of the past and of the existing state of science and engineering, he has succeeded by the provision of introductory exhibits in presenting these records in such a way as to bring them within the ken of the ordinary visitor. Further, by organising a succession of special exhibitions commemorative of scientific men or of notable events ; by presenting the results of the latest scientific research in various fields ; by affording the public glimpses of what public departments are doing to further the advance of science ; by the provision of lectures and of guide lecturers ; by temporary exhibition of objects that have received publicity such as the Schneider Cup hydroplane, he has created widespread interest among all classes of the community, so that the Science Museum always has something fresh for the occasional visitor. So much is this the case that the attendances have gone up from 430,000 in 1925—helped by the opening of the New Building by the King and Queen in 1928—to 1¼ million last year. The number of heads counted is perhaps only a rough criterion of usefulness ; there is the possible danger, too, of a trade element creeping into the exhibitions, but with the surveillance of the Advisory Council of the Museum, which is broad-based in its constitution, such danger should be remote. Finality is, we hope, not by any means reached and we trust that the new director, Brigadier E. E. B. Mackintosh, will not only maintain but also increase the activities of an institution which is now one of London's attractions.

Honorary Fellows of the Royal Society of Edinburgh

THE following elections to honorary fellowships of the Royal Society of Edinburgh were made at the ordinary meeting on July 3 : *Foreign Honorary Fellows* : Prof. John J. Abel, professor of pharmaco-

logy in Johns Hopkins University, Baltimore; Prof. Filippo Bottazzi, professor of experimental physiology in the University of Naples; Prof. Edwin G. Conklin, professor of biology in Princeton University; Prof. Nikolaj K. Koltzoff, professor of zoology in the State University, Moscow; Prof. Albrecht Penck, emeritus professor of geography in the Friedrich-Wilhelms-Universität, Berlin; and Prof. Pieter Zeeman, professor of physics in the University of Amsterdam. *British Honorary Fellows:* Sir George Macdonald, president in 1928 of Section H (Anthropology) of the British Association, and Sir William Napier Shaw, formerly director of the Meteorological Office. The Gunning Victoria Jubilee prize, 1928–1932, was presented to Sir James Walker and the Makdougall-Brisbane prize, 1930–1932, to Dr. A. C. Aitken.

Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund have awarded one hundred guineas each to Dr. Constance F. Tipper (*née* Elam), and to Dr. A. J. V. Underwood. Dr. Elam (Mrs. G. H. Tipper), was an assistant in the metallurgical department at the National Physical Laboratory, Teddington, in 1916–17; and in 1917–27 she worked at the Royal School of Mines, South Kensington, where she was research assistant to Sir Harold Carpenter. During short periods between 1917 and 1928 she also worked in the Cavendish Laboratory, at Cambridge, and at the Davy Faraday Research Laboratory of the Royal Institution. In 1924 she was elected Armourers and Brasiers research fellow in metallurgy and held this fellowship for the maximum period of five years. Since 1928 she has conducted research in the Engineering Department of the University of Cambridge. The greater proportion of Dr. Elam's work relates principally to crystal growth in metals, particularly aluminium. Dr. Underwood is at present practising as a consulting chemical engineer, and is an honorary lecturer in the Ramsay Laboratory of Chemical Engineering, University College, London. Dr. Underwood has published a large number of papers on chemical engineering subjects, notably in connexion with filtration, distillation and flame temperatures. His treatment has been mainly mathematical and he has developed original quantitative methods for interpreting and applying basic chemical engineering processes.

The Schneider Mediumship

FURTHER details of some recent experiments with the Austrian medium, Mr. Rudi Schneider, have been published by the Society for Psychical Research in the issue of its *Proceedings* for June. In a report of a series of sittings, at which Lord Rayleigh and others co-operated, it is stated that attempts to verify the alleged interruption of infra-red rays by some invisible substance or 'force' extruded by the medium were successful, although none of the photographs gave any indication that any material object was interposed. Considerable trouble appears to have been taken in the technical side of the inquiry, although it is a little difficult to understand why, for certain of the experiments, a room was chosen which was extremely susceptible to mechanical vibration, being close to streets bearing heavy traffic and above the lines of the Underground railway. Moreover, the inclusion among the sitters during eight séances of a person who has already been accused of acting as the medium's confederate is not easy to explain, since it is stated that neither the medium nor the individual in question were responsible for the invitation to attend.

APART from these and other criticisms which might be made, the report marks a step forward in the investigation of the Schneider mediumship. Much work remains to be done and, as Lord Rayleigh points out, there is need for patience and perseverance and the avoidance of dogmatism. No good purpose can be served by trying to gloss over unfortunate incidents in the past as the director of these sittings and some of his colleagues are inclined to do. Such incidents as those occurring in Vienna some ten years ago, when Mr. Schneider was accused of freeing a hand by Prof. Stefan Meyer, are not to be neglected, and the full details have just been published as *Bulletin* 5 of the National Laboratory of Psychical Research. Prof. K. Przibram who, with Prof. Meyer, was working with Mr. Schneider, now states that he and his colleague have no reason to believe that any of the phenomena they saw were of a 'psychic' nature. He observes that the phenomena change as methods of control change, so that when one riddle is successfully solved another is then put forward. Thus ten years ago Mr. Schneider was exhibiting the levitation of his own body. To-day he is showing the interruption of infra-red rays by alleged 'supra-normal' means. Indeed the elusive nature of these phenomena inclines Prof. Przibram to be sceptical as to the possibility of sifting "the few grains from the mountain of chaff."

Research Defence Society

IN the annual report for 1932–33 of the Research Defence Society, the Committee surveys the work of the Society during the year in defence of medical research. Mention is made of the final report of the *Field* Distemper Council, which demonstrates that distemper in dogs is almost preventible by the use of preventive vaccine-virus inoculation, the incidence of the disease being reduced thereby from nearly 100 to 1·4 per cent., and the death-rate from 50–75 to only 0·3 per cent. Had the proposed Dogs' Protection Bill, annually introduced into Parliament, passed into law, this research, with so much benefit to dogs and dog-lovers, would have been impossible. Attention is directed to reprehensible types of anti-vivisectionist propaganda, particularly to canvassing consumers and threatening to boycott manufacturing firms which test their food and drug products scientifically before sale to the public. The treasurer, Sir Leonard Rogers, states that the Society's income for the year has been the lowest since 1924, amounting to the modest sum of £776, with which to counter never-ceasing attacks on research workers by anti-vivisection societies, the combined income of three alone of which amounts to £20,000, and he earnestly appeals for additional support.

Importance of Medical and Veterinary Research

MAJOR-GEN. SIR LEONARD ROGERS delivered the seventh Stephen Paget Memorial lecture, entitled "The Saving in Life and Suffering due to Medical and Veterinary Research, with Special Reference to the Tropics", at the annual general meeting of the Research Defence Society held on June 22 at the London School of Hygiene and Tropical Medicine. Sir Leonard dealt with a very wide field of endeavour and conquest in the fight against the diseases of man and animals in the tropics. He outlined the advances made in the treatment of snake-bite, cholera, the dysenteries, Malta fever, relapsing fever and sleeping sickness, giving figures for the incidence and mortality rates before and after the results of research had been applied. In particular, he directed attention to the problem of typhoid fever which faced the Army medical authorities in the South African War and in the War of 1914–18 and exhibited figures proving the enormous value of protective inoculation. He forcefully reminded the audience of the services rendered by Mr. Stephen Paget, whose untiring activity both by lecturing and propaganda among our newly-recruited forces effectively countered the endeavours of anti-vivisectionists to prejudice the soldiers against anti-typhoid inoculation. Dealing with animals' diseases, Sir Leonard showed that on a conservative estimate, half a million cattle are saved annually in India as a result of preventive inoculation against rinderpest or cattle plague. He dealt briefly with distemper and many other diseases of animals and showed conclusively that the saving in life and suffering in animals as a direct result of research far outweighs any discomfort or pain occasioned by the necessary experiments.

Experimental Study of the Nervous System

PROF. ROSS HARRISON'S Croonian lecture, delivered to the Royal Society on June 29, dealt with the origin and development of the nervous system studied by methods of experimental embryology. One of the early questions of importance concerned the manner in which nerve fibres reach their destination, whether by outgrowth from the young neuroblast (His's and Cajal's view) or by progressive differentiation of pre-existing protoplasmic bridges under the influence of functional activity (Hensen's view). Small pieces of embryonic nervous tissue implanted in clotted lymph outside the organism produced nerve fibres more than a millimetre in length without the intervention of other cells and in the absence of cell-bridges. Conditions necessary for the outgrowth of the fibres are a suitable fluid medium, not necessarily nutritive (Lewis) and some form of solid support. By controlling the structure of the fibrin clot, through mechanical tension, the nerve fibres may be made to take more definite paths parallel to the tension lines in the fibrin and may be induced to change their course and to form plexuses (Weiss). The distribution and final connexion of the fibres are determined by the peripheral structures, as is shown by the fact that limbs grafted out of place acquire nerves from the region in which they are planted. WHEN the area of distribution of a sensory nerve is reduced, as when a limb is prevented from developing, its ganglion becomes reduced by hypoplasia; grafting of a limb out of place is followed by hyperplasia in the spinal ganglia supplying it (as shown by Detwiler). After heteroplastic grafting, when the transplanted organ is out of scale with the rest of the animal, the nerve supply is adjusted accordingly; for example, a large tiger salamander limb grafted to a spotted salamander has correspondingly large nerves. The motor nerves are adjusted by more frequent division of the usual number of axones. The sensory nerve fibres, like the spinal ganglion cells, are actually increased in number. The nervous system during development can thus respond to a great variety of changed conditions. By further study of these responses with improved methods of experimentation, it is hoped to obtain a deeper understanding of the processes involved.

Habits of the Horned Toad

THE arrival at the Gardens of the Zoological Society of London of a horned toad (*Ceratophrys ornata*) is an event worth recording. This creature, a native of northern Argentina and Paraguay, where it is known as the 'Escuerzo', is one of ten species noted for their singular coloration and habits. All share the peculiarity of a bony shield underlying the skin of the back. The coloration of *C. ornata* is protective in character and of considerable beauty. The greenish-yellow background is relieved by large dark green patches on the back, decreasing in size on the flanks. Each of these isolated patches is surrounded by a narrow line of white and yellow dots, interspersed with lines of rusty brown or red, producing a carpet-like pattern perfectly concealing the half-buried body. If there is not sufficient green vegetation it throws earth upon its back by the aid of the hind feet, and at the same time the skin wrinkles, and assumes a duller coloration. Extremely sluggish, it lies in wait for its victims, which include smaller members of its own species, as well as frogs, which are said to form its staple diet. Horned toads are said to inflate the body when angry, and to hop backwards and forwards uttering a succession of loud cries, hence they are also known as 'crying frogs'. As the cause of their excitement is removed, they slowly deflate the body and relapse into the stony silence enjoined by the need of fresh victims. During the dry season, like many other batrachians living in hot countries, they æstivate.

An Unusual Rainbow Phenomenon

AN account has been received from Mr. J. L. Horton, 103 Colworth Road, Leytonstone, London, E.11, of an unusual rainbow phenomenon observed between 8.20 and 8.30 p.m. on June 26. There was a primary bow of the usual kind (violet nearest to the sun), and a secondary bow farther from the sun (with colours reversed). Unusual features were two fainter and narrower bows; one lay immediately adjoining the primary bow on its inner side, with colours arranged in the same order ranging from

violet to green, so that the green of the narrower bow lay next to the violet of the primary bow; the other lay immediately outside the secondary bow and had colours in the same order as the primary bow and its companion. The primary bow was visible for longer than the other three. Some, at least, of the rain which gave rise to the four bows was associated with a distant thunderstorm. An explanation must presumably be sought in a probable grouping of the raindrops into at least two principal sizes, the larger drops being no doubt produced in the thunderstorm, for it is known that drops of different sizes produce bows of different coloration and width. The fact that the two outer bows had their colours arranged in opposite order, however, seems difficult to reconcile with this suggestion. Accounts from other observers would be of interest.

Sea-Waves of the Japanese Earthquake of March 2, 1933

THE great earthquake of March 2, that originated near the western edge of the Tuscaroora Deep, was registered by seismographs at the three Hawaiian observatories of Kilauea, Kona and Hilo (*Volcano Letter*, Hawaiian Volcano Observatory, No. 397, March, 1933). As the seismograms showed that the distance of the origin was about 3,950 miles in the direction of Japan, it was clear that the movement might be followed in about 8½ hours by seismic sea-waves. Notice was sent to the harbour-masters in the islands that waves might be expected at about 3.30 p.m. (Hawaiian time), and in consequence the fishing-boats were moved out to sea and many of them were no doubt saved by these timely precautions. The waves entered Hilo, on the east side of Hawaii, at 3.36 p.m., and continued to sweep in for about two hours, the greatest range of motion being 2–3 ft. On the west side of Hawaii, the sea-level with the greatest wave fell 8 ft. and rose 9½ ft.; walls were washed away and boats left in the ports were unmoored and capsized. At Honolulu, the first waves arrived at 2.40 p.m. or about 7h. 40m. after the earthquake occurred in Japan. In 1896, the interval was 7h. 44m., and thus it may be inferred that the foci of the two earthquakes were not far apart.

Photoelectric Cell Applications at the Science Museum

THE special exhibition of photoelectric cells and their practical applications, which has been on view at the Science Museum since March, has proved of such interest both to specialists and to the general public that it has been decided to extend it up to the end of September. Almost without exception the firms and individuals who originally lent apparatus for inclusion in the exhibition have kindly consented to continue the loan for the further period. While the essential features of the exhibition will thus remain unchanged, several interesting additions have recently been made. Prominent among these is a 'chart analyser', lent by the Post Office Engineering Research Station, which analyses records of the alternating periods of 'use' and of 'idleness' of certain pieces of apparatus employed in automatic telephony. These records are passed beneath a photoelectric cell connected to amplifying apparatus which records upon two dials the desired information—the total duration of the periods of 'use' and their number. A further exhibit has been prepared to illustrated the application of photo-electric cells in the transmission of pictures, telegrams, etc., by line or radio telegraphy; some early apparatus used for this purpose and some of the first pictures actually transmitted are shown. Among new instruments added since the exhibition was opened are a direct-reading portable illumination meter and the 'blancometer', which measures accurately the departure from a standard whiteness of a nearly-white surface.

Long Steel Castings for Cotton Presses

IN discussing the first report of the Steel Castings Research Committee of the Iron and Steel Institute recently, Sir Robert Hadfield referred to some hydraulic cylinders made by Messrs. Hadfields, Ltd. for cotton presses. These cylinders, which had an overall length of nearly 27 ft., required the production, including the feeder head, of castings some 32 ft. long. They were cast vertically at a temperature of about 1,530° C. and contracted in solidification and subsequent cooling by about 8 in. To permit of this considerable change in length, the clamped moulding box must be removed almost immediately after the steel has set. Since these castings are tested hydraulically at pressures in some cases up to 4 tons per sq. in., and since the working pressure amounts to 2½ tons per sq. in., it is clearly necessary that they should be completely free from the least suspicion of unsoundness of any sort. Their outside diameter was 15 in. and wall thickness only 2⅛ in. Their production represents a noteworthy achievement. A drawing showing the casting process was exhibited at the Royal Society soirée on June 21.

The State and Economic Life

A PAMPHLET entitled "The State and Economic Life" recently issued by the International Institute of Intellectual Co-operation, summarises opinions reached during the Sixth International Studies Conference. Among the more important matters discussed was that of international capital movements. It is pointed out in the report, that since the War there has been unwise and excessive lending abroad, which is partly responsible for the present position. The general economic disequilibrium created an abnormal demand for foreign credit and this was intensified by the huge amounts of inter-governmental indebtedness. Foreign loans were often obtained to cover budgetary deficits, to stabilise temporarily balances of payments or for unjustifiably extravagant purposes. Such borrowing, though it may have delayed the international collapse, has certainly contributed to the gravity of the crisis. Furthermore, unstable conditions increased speculative facilities and abnormal interest rates gave rise to an unprecedented volume of international short-term lending. To-day the almost complete cessation of international financial trans-

actions is partly responsible for the delay in world recovery. Previous excessive borrowing, impoverishment of borrowers and the excessive fall in prices have led to much partial or complete default. For the immediate future, no purely financial measures are deemed sufficient as a means of reviving the normal flow of capital. The immediate need is to restore conditions of political security, since only in this way can confidence be resuscitated. For the remoter future, various methods for the control of international capital movements are recommended and it is urged that these should be considered without delay.

Electric Power Supply in Great Britain

IN the *Electrical Review* for June 30 an account is given of the opening of the World Power Conference at Copenhagen on June 26. At a technical meeting an important paper was read by H. Hobson, F. Forrest and C. D. Taite giving a survey of the industrial electric power supply in Great Britain. In Germany, the United States and France, the percentage of the working population engaged in manufacturing industries is 59·8, 56·2 and 46·8 respectively. In Great Britain the corresponding figure is 73·5, the power supply being of predominant importance. The want of co-ordination and piecemeal development of public electricity supply has in the past led many industrialists to manufacture their own electric power. When the industrial output is low, the overhead charges of these private generating stations have proved a heavy burden on industry. Figures are given showing the great increase in the horse power per worker employed in the manufacturing industries which has recently occurred. The English 'grid' not only accelerates the operation of the various influences making for economy but also introduces new factors in the economics of public electricity supply. The generation of energy is concentrated in a limited number of inter-connected stations. This makes possible an increase in the thermal efficiency of generation and the more economic employment of capital and labour. In 1931 the average fuel consumption at stations to be closed down was 2·19 lb. per kilowatt hour. At the selected stations with an output exceeding 100 million kwh. per annum it was 1·54 lb. A considerable economy of fuel has thus been effected. Private industrial plants are rapidly becoming obsolescent. In some cases the supply authorities are taking over the responsibility of operating the private plant during the remainder of its life before a public supply is installed.

Annual Meeting of 'Dechema'

A NUMBER of technical papers were read at the Dechema (German Chemical Apparatus Society) annual meeting at Würzburg on June 8–9, among which reference may be made to a few. Dr. W. J. Müller of Vienna, who is seeking a logical method of teaching chemical engineering, whilst approving the American plan of sub-division of the mechanical side according to the operations which are usually performed, for example, filtration, distillation, drying, etc., makes the suggestion that chemical technology should be taught according to a scheme based on the nature of the phases concerned in the reactions, for example, solid and solid, solid and liquid, solid and gas, etc., seven in all of such phase combinations being possible. His new method is elaborated in his lecture, the chief claim for it being that it distinguishes between what is general and what is exceptional in chemical technology. The development and position of the safety glass industry was described by F. Ohl of Darmstadt; such glass has now come generally into use for a great variety of purposes, while its manufacture has reached a high standard. E. Risemann of Frankfurt brought up to date the story of the use of active carbon in solvent recovery and for the scrubbing of gases. In technical work, nearly complete recovery of an organic solvent, even from very dilute air mixtures, is attained; whilst the plant has been simplified and cheapened, the operating cost being less than ½*d.* per kilo recovered. Practically twice as much light petrol is scrubbed out of a gas of the same composition at the well head as a few years ago, plants yielding as much as 100 tons per day being in operation. For the scrubbing of a benzol of high quality out of town gas, a new carbon has been brought into use of which very much less is required. The large installations in London and Paris are working well and another is under construction at Budapest.

British Postgraduate Medical School

ON July 17 at 4 p.m. the Right Hon. Neville Chamberlain will lay the foundation stone of the British Postgraduate Medical School buildings at the L.C.C. Hospital, Ducane Road, London, W.6, thus marking a further stage in bringing into practical operation the scheme recommended by the Postgraduate Medical Education Committee appointed in 1925. The scheme is founded upon the association of the new medical school with a public hospital administered by the London County Council. The Government has agreed to contribute a maximum of £100,000 for the building and equipment of the School, and the London County Council has agreed to incur an equivalent expenditure on such developments and adaptations of the Hospital as are found to be necessary at the present time in view of its forthcoming association with the School. The Government has undertaken to provide in due course for annual grants towards the maintenance of the School as a recognised School of the University of London. The new postgraduate teaching hospital will doubtless attract medical men to London from all parts of the world, and especially from the British Dominions and Colonies overseas, and will serve to establish London as one of the chief centres in the world for medical training and research.

Announcements

SIR ROBERT A. HADFIELD, Bt., has been awarded the decoration of Commendatore of the Order of the Crown of Italy, "in recognition of general scientific work".

PROF. D. F. FRASER-HARRIS has recently been awarded by the University of Glasgow the triennial prize in the history of medicine, 1932–33, for an essay entitled "Antiseptics before Lister".

THE Howard prize of the Royal Meteorological Society has been awarded to Cadet J. S. Robertson of H.M.S. Training Ship *Conway* for the best essay on "Visibility and Fog". The prize takes the form of an aneroid barometer, suitably engraved, and is competed for annually by cadets of H.M.S. *Worcester*, H.M.S. *Conway*, the Nautical Training College, Pangbourne, and South African Training Ship *General Botha*.

THE Institute of Radio Engineers of New York has awarded its Gold Medal of Honor this year to Sir Ambrose Fleming for the conspicuous part he has played in introducing physical and engineering principles into the art of radio. Sir Ambrose was the inventor of the first form of thermionic valve, which is now the master weapon of wireless telegraphy and telephony, and without which there would have been no broadcasting as it exists to-day.

DR. P. STOCKS, reader in medical statistics in the Francis Galton Laboratory for National Eugenics, University of London, has been appointed medical statistical officer in the General Register Office.

IT is announced by Science Service that Dr. Isaiah Bowman has been elected chairman of the U.S. National Research Council, succeeding Dr. W. H. Howell, formerly director of the School of Hygiene and Public Health of Johns Hopkins University. Dr. Bowman is director of the American Geographical Society. He has performed valuable services to geography, especially regional and political, and was leader of several important geographical expeditions between 1907 and 1913.

THE Royal Cornwall Polytechnic Society will celebrate its centenary on July 18–21 under the presidency of the Right Hon. Viscount Clifden. Several interesting functions have been arranged to take place in various parts of Cornwall, including Falmouth and Penzance. Among the lectures announced to be given are the following : Sir Richard Gregory, "Science applied to Industry" ; Sir John Cadman, "Science—one and all" ; Sir W. Napier Shaw, "Unofficial Meteorology" ; Dr. G. C. Simpson, "Modern Methods of Forecasting" ; and Prof. S. J. Truscott, "Problems of Mining at great Depths". Further information can be obtained from the Secretary, Mr. E. W. Newton, Polytechnic Hall, Falmouth.

AN exhibition of the finds of the Wellcome-Colt Archæological Expedition at Tell Duweir in Southern Palestine (see NATURE, June 24, p. 897) will be open at the rooms of the Palestine Exploration Fund at 2 Hinde Street, Manchester Square, London, W.1, on July 17–August 4.

A MEETING of the Executive Committee of the International Population Union was held under the chairmanship of Sir Charles Close (president), on June 27–28. Dr. E. Fischer, who was recently appointed rector of the University of Berlin and is also director of the Kaiser Wilhelm Institut für Anthropologie, conveyed on behalf of his Government an invitation to the Union to hold its next (third) general assembly and international congress in Berlin in September, 1934. This invitation was accepted on behalf of the Committee by Sir Charles Close.

THE Botanical Institute of the Soviet Academy of Science has completed a work in twenty volumes on "The Flora of the U.S.S.R.". The work has been compiled under the guidance of V. L. Komarov, vice-president of the Academy, and is founded on the rich herbarium of the Botanical Institute, including more than 20,000 kinds of plants of the U.S.S.R. The early volumes of the work are in type and will shortly be published.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A computor (Class II) for the Ordnance Committee, Royal Arsenal, Woolwich, London, S.E.18—The Secretary (July 10). A temporary civil engineering assistant for the Directorate of Works, War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (July 12). A junior full-time lecturer in chemistry at the Woolwich Polytechnic, London, S.E.18—The Secretary (July 12). A scientific instrument maker and repairer at the Bradford Technical College—The Director of Education, Town Hall, Bradford (July 12). Chemists for the Department of the Government Chemist—Government Chemist, Clement's Inn Passage, Strand, London, W.C.2 (July 17). An assistant naturalist (male) in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (July 17). An assistant education officer (technology) for the London County Council—The Education Officer (Establishment), County Hall, London, S.E.1 (July 17). A demonstrator in human physiology at the University of Manchester—The Registrar (July 20). A veterinary assistant for the Veterinary Laboratory of the Ministry of Agriculture and Fisheries, New Haw, Weybridge, Surrey —The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (July 22). Two European engineer sub-lieutenants for the Royal Indian Marine—The Secretary, Military Department, India Office, London, S.W.1 (August 1). A professor of organic chemistry at the Indian Institute of Science, Bangalore—The Director (September 30). A head of the Mechanical Engineering Department of the Rugby College of Technology and Art—The Principal, 61, Clifton Road, Rugby.

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.*]

Latitude Effect of Cosmic Radiation

ON the expedition organised by the Deutscher und Oesterreichischer Alpenverein in 1932 to the Andes of Peru, observations of cosmic rays were made at several heights up to 6,100m. and during the sea-voyage. From Bremen to Peru one apparatus worked during March and April 1932 on board the M.S. *Erfurt* of the Norddeutscher Lloyd line. On the return voyage in January and February 1933, three apparatuses were in full action from Peru through the Strait of Magellan to Hamburg on board the M.S. *Isis* of the Hamburg-Amerika line. The self-recording electrometers were constructed by Prof. E. Regener on the same principle as those used for his researches in Lake Constance[1] and in the upper atmosphere[2]. The electrometer wire is inside an ionisation chamber of 16 cm. diameter with 'deltametal' walls of 1 cm. thickness. The position of the wire is photographed every half-hour on a fixed photographic plate.

Instrument No. 1 was filled with carbon dioxide at 9·7 atmospheres pressure and 16° C. With a radium capsule, I found the temperature effect on ionisation to be + 0·13 per cent for every + 1° C. difference. The correction for barometric pressure was 0·29 per cent per millimetre of mercury. All data were reduced to 16° C. and 760 mm. pressure. The ionisation due to radioactivity in the chamber itself was allowed for as 0·8 volts per hour as found on the bottom of Lake Constance at a depth of 250 m. Eight hemispherical shells of iron were fitted round the chamber. The combined thickness of this iron wall was 10 cm.

In Fig. 1 are recorded the data of apparatus No. 1, the iron case of which was open on the upper side. The graph shows the intensity of cosmic radiation in volts per hour for different geomagnetic latitudes on the voyage from the Strait of Magellan to Hamburg. The geographical position of the geomagnetic north pole was taken to be 78° 32′ N. and 69° 08′ W. Each point of the curve corresponds to an average of a twenty hours' registration. The points give a smooth curve which shows the accuracy of the recording method employed. The intensity increases by about 12 per cent when going from the equatorial region to 55° N. geomagnetic latitude.

Apparatus No. 2 was wholly encased in the iron shell. Apparatus No. 3 worked without any iron shell. Every instrument shows substantially the same effect.

In general, the curves agree with the observations of Clay[3] and with those of A. H. Compton[4] made at about the same time. It is very interesting that the northern and southern parts of the curve are *not* symmetrical with respect to either the geomagnetic or the geographical equator. Considering the accuracy of our uninterrupted registration, this result is quite trustworthy.

From the fact that a latitude effect of 12 per cent of the radiation exists, it must be concluded that this part of the radiation consists of corpuscles before entering the earth's atmosphere. For the magnitude of this part of the radiation, reference should be made to the analysis of the components of cosmic rays by Regener[2] and Lenz[5].

A more detailed report of these observations and of the researches in the Andes will be published in the *Zeitschrift für Physik*.

H. HOERLIN.

Physikalisches Institut
der Technischen Hochschule,
Stuttgart. June 8.

[1] Regener, E., *Z. Phys.*, **74**, 433; 1932.
[2] Regener, E., *Phys. Z.*, **34**, 306; 1933.
[3] Clay, J., *Naturwiss.*, **20**, 687; 1932.
[4] Compton, A. H., *Phys. Rev.*, **43**, 387; 1933.
[5] Lenz, E., *Z. Phys.*; in the press.

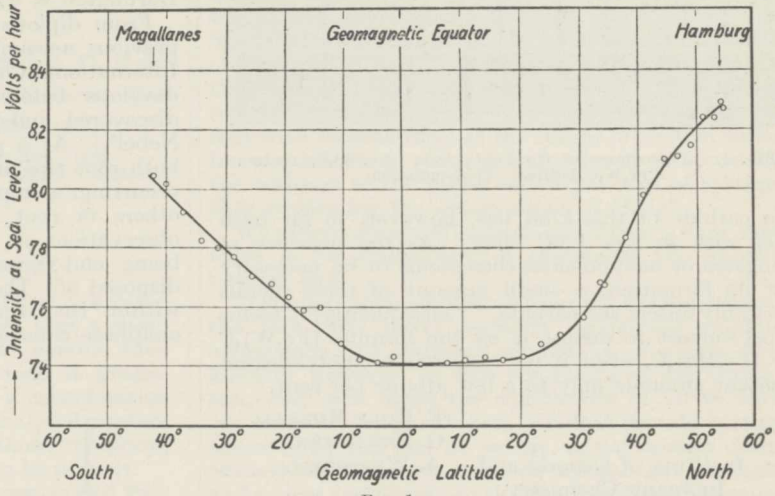


FIG. 1.

Carbides of Low Tungsten and Molybdenum Steels

A FEW years ago, W. A. Wood made an X-ray analysis of residues obtained from tungsten magnet steels by electrolytic dissolution of their iron phases[1]. He could prove the presence of the carbides WC and Fe_3W_3C (with some of its tungsten substituted by iron), which latter had been previously found in high-speed tool steels[2].

On repeating this investigation we have come to the same conclusion as Wood regarding the presence of WC and Fe_3W_3C, but in addition to these carbides we have found a third one. In our photograms we have discovered a line series corresponding to a phase having the same face-centred cubic structure as Cr_4C.[3] Its interference lines are not only present but even stronger, when the residue is obtained from a magnet steel without any chromium. The phase can thus not be chromium carbide. Its lattice parameter is 10·51 A. which is somewhat less than that of Cr_4C (10·64 A.). This indicates that the carbide consists of Fe_4C, with a little of its iron substituted by tungsten.

This new carbide is present also in high-speed steels but only to a very small amount. In Fe-W-C

alloys low in tungsten, for example, in specimens containing 2 per cent tungsten and about 1 per cent carbon, it seems to be the only carbide present. A photogram of a residue obtained from an alloy of that kind is shown in Fig. 1, where it is compared to a photogram of $(Cr,Fe)_4C$ isolated from stainless chromium steel and also to a photogram of Fe_3W_3C. In Fe-W-C alloys containing still less tungsten, for example, 1·5 per cent tungsten, and 0·5–1 per cent carbon, the new carbide occurs in mixture with cementite. It is also present in low molybdenum steels.

A chemical analysis of a residue consisting mainly of the new carbide has confirmed our supposition that it may be considered essentially to be Fe_4C.

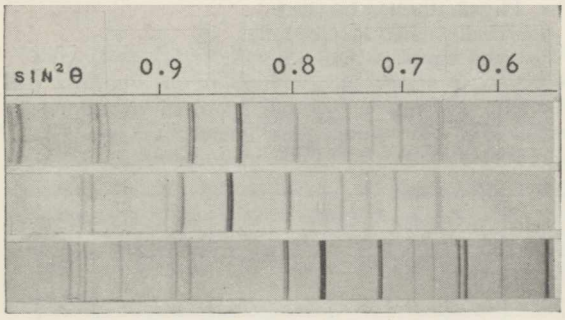


FIG. 1. Photograms of $(Cr,Fe)_4C$, top; $(Fe,W)_4C$, centre; Fe_3W_3C, bottom. Cr-*K*-radiation.

No carbide of this kind has, however, so far been met with in any Fe-C alloy. As the presence of tungsten or molybdenum thus seems to be necessary for its formation, a small amount of these metals certainly enters the carbide. Consequently, it seems most correct to denote it by the formula $(Fe,W)_4C$ or $(Fe,Mo)_4C$, even if its tungsten or molybdenum content amounts only to a few atomic per cent.

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G. PHRAGMÉN.
A. WESTGREN.

Institute of General and Inorganic Chemistry, Metallographic Institute, Stockholm. May 26.

[1] *Phil. Mag.*, 7, **10**, 659; 1930.
[2] Westgren and Phragmén, *Trans. Amer. Soc. Steel Treating*, **13**, 539; 1928.
[3] Westgren and Phragmén, *K. Vetenskapsakademiens Handl.*, III : **2**, No. 5; 1926.

Mitosis and Meiosis

FROM observations made in this laboratory by S. G. Smith, E. Marie Hearne, Jane D. Spier, J. M. Armstrong, A. W. S. Hunter, and me on meiosis and both haploid and diploid mitosis in *Trillium*, *Matthiola*, a number of cereals and grasses, and in grasshoppers, it can be shown that, at all stages of mitosis and meiosis, chromosome threads are attracted in pairs and that pairs of pairs are repulsed. A unified theory of chromosome behaviour thereby arises which seems adequately to explain the mechanism of both mitosis and meiosis, including the varied behaviour of univalents in the latter. Fig. 1 illustrates essential features, broken lines indicating stages during which splitting of the chromosomes can be seen to be occurring. (Throughout this note it is "effective" lateral splitting which is referred to; if Nebel's, unpublished, observations in *Tradescantia reflexa* are confirmed for other material the initiation of the split occurs one division cycle earlier.)

These observations were stimulated by Darlington's precocity theory of meiosis (which Dr. A. H. Sturtevant in his recent review in NATURE of January 7, p. 5, states that he favours) and the new unified theory has, of course, features in common with it as well as with more generally accepted accounts. Briefly, according to our observations, chromosome behaviour in mitosis and meiosis is as follows: at the earliest prophase stage of mitosis the chromosomes are double; in meiosis they are single. The single threads pair in meiotic zygotene; during pachytene the 'secondary' split occurs. Repulsion between pairs of chromatids begins with the 'secondary split' but in *most* organisms the pairs are held together by changes of partner or chiasmata. So far we agree with Darlington, except that he has attributed universality to the chiasma mechanism. As I have pointed out elsewhere[1], the work of Wilson and the Schraders shows conclusively that it has not universal application, and almost equally certainly Darlington is wrong in applying it to *Drosophila*.

From diplotene on, our observations differ from previous accounts. As demonstrated at the Sixth International Congress of Genetics[2], a 'tertiary' split develops before meiotic metaphase. (This was discovered independently and simultaneously by Nebel[3].) At a parallel stage of mitosis we find, in both root tips and the haploid pollen grains, a split occurring, as reported by Sharp[4], Hedayetullah[5] and others in root tips. Darlington rejected Sharp's observations as "optical illusions". Some of ours being end-views of chromosomes cannot thus be disposed of. The 'tertiary' split initiates a repulsion within the 4-partite daughter chromosomes, at anaphase causing their arms to separate widely and

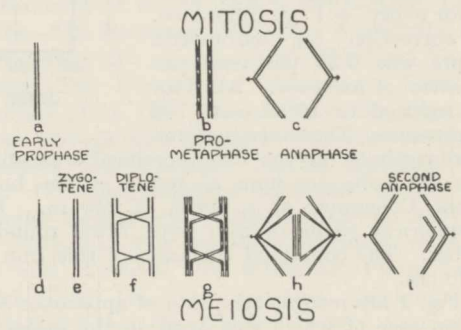

FIG. 1. Diagram of mitosis and meiosis. A univalent is included in *h* and *i*.

preparing them for the second meiotic division, in which we find the pre-metaphase split omitted. Omission of a split in one division is, of course, essential to reduction. It follows as a mechanical consequence of the preceding stages as here described. The splitting of univalents in both divisions, which occurs chiefly when there are many of them, is apparently due to their delaying the second division and thus permitting the ordinarily omitted pre-metaphase split to occur. It is inexplicable on Darlington's view that splitting occurs during the resting stage.

It is from this view that practically all the contradictions in Darlington's precocity theory arise. From it he is forced to assume that though at

prophase single threads attract one another, they repulse one another at anaphase. To get around this duality of principle, he suggests[6] (p. 48) "It may be that the . . . spindle attachment . . . has not the property which the chromatids have, of associating in pairs". Again (p. 300) he assumes that though the chromosomes divide during the resting stage, their attachments divide at metaphase. Both these assumptions are theoretically inadequate and, according to us, observationally invalid. Finally, though the object of his precocity theory is to homologise mitosis and meiosis, Darlington is left at the end (p. 305) with a basic duality of principle: "Perhaps all nuclear division, *apart from the first division of meiosis* [my italics], is determined by division of the chromosomes."

The observations here summarised show this duality to be non-existent; the principle of attraction between single threads and repulsion between pairs of pairs, postulated by Darlington for the prophase only and denied by him at anaphase, really applies at all stages of mitosis and meiosis.

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[1] Huskins, C. L., *Trans. Roy. Soc. Canada*, **26** (Sect. V), 17–28; 1932.
[2] Huskins, C. L., Smith, S. G., *et al.*, Proc. Sixth Internat. Cong. Genetics, **2**, 95–96, 392–393 and 396; 1932.
[3] Nebel, B. R., *Z. Zell. Micro. Anat.*, **16**, 251–284; 1932.
[4] Sharp, L. W., *Bot. Gaz.*, **88**, 349–382; 1929.
[5] Hedayetullah, S., *J. Roy. Micro. Soc.*, **51**, 347–386; 1931.
[6] Darlington, C. D., "Recent Advances in Cytology" (Churchill and Co., London), 1932.

Cystine and Wool Production

RECENTLY, Rimington and Bekker[1] directed attention, in these columns, to the fact that a sheep apparently produces in its fleece more cystine than it takes in in the herbage upon which it grazes. This conclusion was arrived at after a consideration of the results of those[2,3,4] who have analysed pasture grasses, etc., for cystine and have, without exception, found only traces of this amino-acid to be present.

It was suggested that the bacteria, yeasts and Protozoa inhabiting the rumen and digestive tract of the sheep are able to utilise non-cystine sulphur compounds for the synthesis of cystine, built into their intracellular protoplasm; that by death and autolysis of the micro-organisms, this cystine might then become available for absorption by the sheep.

Woodman and Evans[5] have subjected this hypothesis to some criticism and in particular have questioned two of the figures fundamental to the argument, the cystine content of the pasture and the weight of wool produced by a sheep. They assert that Evans[3] has shown cultivated English pasture to contain about 0·1 per cent of cystine, whereas we took 0·01 per cent as an average figure and they take the average wool production per head of sheep as 5–6 lb. of raw wool in place of the 12 lb. used in our calculations. They assert that there is no inadequacy of cystine in the diet.

In the following paragraphs we propose to show that, *so far as can be ascertained from available analyses*, our figures are justified and that such an inadequacy does exist; also to adduce further evidence in favour of our hypothesis.

With regard to the figure to be taken as truly indicating the cystine content of pasturage, Evans in the summary to his paper[3] states that, "The Sullivan colorimetric method showed that only a trace of cystine was present [in pasture grasses] although the addition of cystine to the hydrolysate proved the method to be applicable". Evans also calculated the 'cystine' content from the percentage of labile sulphur, after quoting a table to show that by this method "protein sulphur other than that present as cystine gives rise to sulphide sulphur", and found approximately 0·1 per cent. It is this 0·1 per cent which Woodman and Evans have selected for their calculations in preference to our estimate of 0·01 per cent of cystine in the weight of dry herbage.

Our figure of 0·01 per cent was adopted as a fair average value after a consideration of Evans's own work, that of Aitken[2] and the more recent results of Henrici[4] on South African Karroo pastures sampled in the districts which support the greater part of the Union's sheep population.

Woodman and Evans's next point concerns the weight of the fleece. English sheep may produce only 5–6 lb. of raw wool, but for the South African merino sheep grazing on these Karroo plants an average clip of 12 lb. is nothing unusual. Stud sheep have been known to yield much more; the South African record is held by a stud ram which clipped a 46 lb. fleece. The animal's ration during this time consisted almost entirely of lucerne. Kellermann (unpublished data) has shown that rats fed upon a diet with lucerne meal as the source of protein suffer from a deficiency which is immediately removed by the addition to the ration of 0·1 per cent of cystine, thus confirming the observations of Haag[6].

We cannot accept Woodman and Evans's view that there is no inadequacy of cystine in the sheep's natural diet.

Turning to their remarks concerning our hypothesis, the fact that many bacteria decompose sulphur compounds into hydrogen sulphide is, of course, well known; however, *in vivo* conditions of absorption, etc., may well upset the equilibrium of an *in vitro* reaction. One may ask how it is that protein cystine taken in by the rat, let us say, is not broken down entirely to hydrogen sulphide by the gut bacteria and so lost completely to the organism for absorption and synthetic purposes. However, if proof is needed of the synthesis of an important sulphur-containing compound by bacteria, it can be found in the case of the synthesis of vitamin B_1 by bacteria (*Flavobacterium vitarumen*) in the rumen of the cow as proved by Bechdel, Honeywell, Dutcher and Knutsen[7]. Windaus[8] has shown that vitamin B_1 is a sulphur-containing compound having the probable formula $C_{12}H_{17}N_3OS$. Zschesche[9] comes to similar conclusions. Sugata and Kock[10] studied the growth of yeast upon artificial medium to which various forms and amounts of sulphur were added. Sulphate sulphur was the most available form, it being converted into yeast protein and probably, at least in part, into cystine.

The finding, subsequent to our first publication, that methionine can replace cystine for body growth in rats[11] has introduced a further complication into the argument, but it must be noted that the replacability for hair growth has not yet been demonstrated.

A final reference must be made to the alternative hypothesis put forward by Fraser and Roberts[12] that the wool follicle may have the power of synthesising cystine. If this were so, it would be difficult to understand why rats fed upon a cystine-deficient diet

revert to the puppy coat with a much lower cystine content than the adult hair[13].

We have experiments in progress designed to test the validity of our hypothesis. It is, unfortunately, too early as yet to cite results, but these will be presented without delay as soon as they become available.

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J. KELLERMANN.

Onderstepoort Veterinary Research Laboratory,
Pretoria, South Africa.
March 8.

[1] Rimington and Bekker, NATURE, **129**, 687, May 7, 1932.
[2] Aitken, *Biochem. J.*, **24**, 250; 1930.
[3] Evans, *J. Agric. Sci.*, **21**, 806; 1931.
[4] Henrici, Eighteenth Report Dir. of Vet. Services and Animal Ind., Pretoria, August 1932, p. 579.
[5] Woodman and Evans, NATURE, **130**, 1001, Dec. 31, 1932.
[6] Haag, *J. Nutr.*, **4**, 363; 1931.
[7] Bechdel, Honeywell, Dutcher and Knutsen, *J. Biol. Chem.*, **80**, 231; 1928.
[8] NATURE, **129**, 161. Jan. 30, 1932.
[9] Zschesche, *Chem. Z.*, **56**, 166; 1932.
[10] Sugata and Koch, *Plant Physiol.*, **1**, 337; 1926.
[11] Weichselbaum, Weichselbaum and Stewart, NATURE, May 28, 1932, p. 795.
[12] Fraser and Roberts, NATURE, **130**, 473, Sept. 24, 1932.
[13] Lightbody and Lewis, *J. Biol. Chem.*, **82**, 663; 1929.

Lability of the 'Reducing Factor' (Vitamin C?) in Milk

FOR some time past the effect of various factors on the vitamin content of milk of a 'typical' English herd has been under investigation in this Institute. In the course of this work an endeavour has been made to measure the rather low vitamin C potency of milk, using guinea pigs for the biological test.

Recently Tillmanns's chemical test[1] for vitamin C as modified by Birch, Harris and Ray[2] has been applied by us to this 'typical' milk, that is, to mixed samples of evening and of morning milk of our herd of shorthorns, the diet and management of which is typical of the agricultural practice in the south of England, and also to morning's milk as put out for sale by our experimental dairy; lastly to morning's milk of individual cows. Some of the data are given in the accompanying table, in which the figures shown represent the number of cubic centimetres of the trichloracetic acid filtrate from milk necessary to decolourise 0·05 c.c. of a 0·1 per cent solution of 2·6 dichlorophenol-indophenol; that is, the presumptive vitamin C content of the milk is proportional to the reciprocal of the titration figures. The 'type milk' was titrated in the morning within one hour of delivery from the dairy. This milk was made up of two parts evening's milk approximately 16 hours old and three parts morning's milk, approximately 1 hour old. Bottles of sale milk were left in the retail crates until needed for titration.

'Type Milk'		Sale Milk (Bottled)		Milk of Individual Cow.	
Date	Titration	Date	Titration	Time after milking	Titration
April 10	3·27 c.c.	April 26	2hr. after milking 1·07 c.c.	April 24	
			5½ ,, ,, ,, >5·00 ,,	5 min.	0·900c.c.
,, 11	2·10 ,,	,, 28	2 ,, ,, ,, 5·00 ,,	1 hr.	0·975 ,,
,, 20	>5·00 ,,		4 ,, ,, ,, >5·00 ,,	2 ,,	1·02 ,,
cows went	out on grass	May 11	2 ,, ,, ,, 1·70 ,,	3 ,,	1·10 ,,
,, 21	2·62 ,,		4½ ,, ,, ,, >5·00 ,,	4 ,,	1·23 ,,
,, 22	3·85 ,,	,, 31	15 ,, ,, ,, 0·620 ,,	5 ,,	1·50 ,,
,, 24	0·95 ,,		2½ ,, ,, ,, 2·20 ,,	8 ,,	1·90 ,,
,, 26	0·89 ,,			10 ,,	2·25 ,,
,, 28	2·20 ,,				
May 11	1·84 ,,				

Whatever its nature, it is evident even from the figures shown in the table that the quantity of the substance (or substances) in milk responsible for the reduction of the chlorophenol-indophenol reagent is subject to marked and irregular fluctuations. In this respect our findings are in agreement with those recently published by Schlemmer, Bleyer and Cahnmann[3], who use a somewhat different method of precipitation and titration, but whose published figures show similar irregularities. If—and the weight of evidence is at present in favour of such a view—this substance is identical with vitamin C, it would appear that, under existing conditions, the presence of vitamin C in reasonable amounts cannot be guaranteed even in very fresh milk samples of high quality produced under first class conditions of feeding and management.

Under natural conditions milk is always in contact with living tissue, and passes direct from mother to suckling without change of temperature or exposure to air. The rapid disappearance of the reducing substance (whatever its nature) emphasises the suddenness with which a train of changes sets in in milk as soon as it leaves the udder.

We are at present engaged in a further study of the dynamics of this extremely labile system in milk.

S. K. KON.

National Institute for Research
in Dairying,
Shinfield, Nr. Reading.
June 1.

[1] *Z. Unters. Lebensmittel*, **60**, 34; 1930; *Biochem. Z.*, **250**, 312; 1932.
[2] *Chem. Ind.*, **52**, 159; 1933; *Biochem. J.*, **27**, 590; 1933. I am greatly indebted to these gentlemen for particulars of their method before publication.
[3] *Biochem. Z.*, **254**, 187; 1932.

Double Refraction of Oriented Surface Layers

WE have extended the scope of a method recently described[1] for the measurement of refractive indices of liquids in thin films, and have obtained evidence of the double refraction of the interfacial layer between melted normal fatty acids and glass. Acids with more than ten carbon atoms in the chain are being examined. The birefringence is small, usually less than 0·0001, and exists only over a narrow temperature range of a few degrees immediately above the solidification point of the acid. This provides optical evidence that the molecules of the fatty acids are oriented at a glass-liquid interface to a depth comparable with a wave-length of visible light[2]. The sharpness of disappearance of the birefringence at a critical temperature is thought to indicate that the anisotropic layer is a new phase, and that the fatty acid behaves as a 'liquid crystal' immediately above its solidification point.

The results of the work are shortly to be published in the United States, but meanwhile we take this opportunity of thanking Prof. E. K. Rideal, of Cambridge, who suggested that the problem would repay our attention.

A. M. TAYLOR.
ALLEN KING.

Institute of Applied Optics,
University of Rochester, N.Y.
June 6.

[1] Taylor and Glover, *J. Optical Soc. Amer.*, **23**, June 1933.
[2] Trillat, *J. Phys. Radium*, **10**, 32; 1929.

Positrons and Atomic Nuclei

IN NATURE of May 27, Dr. W. Elsasser offers evidence in favour of the suggestion that the proton consists of a neutron and a positron. Examining the question from a different point of view, I put forward the following as evidence against the suggestion.

If we allow that an atomic nucleus may contain α-particles, protons, neutrons, electrons and positrons, the number of possible structures for a nucleus of atomic mass P and atomic number Z increases rapidly with increase of P and Z, and for the heavy atoms it may run into hundreds. If we exclude the possibility of unattached electrons and positrons in the nucleus, then the structure becomes unique and is given by

$$\tfrac{1}{2}(Z-p)\ \alpha\text{-particles}+(P-2Z+p)\ \text{neutrons}+p\ \text{protons} \quad . \quad . \quad (1)$$

where $p=0$ or 1, whichever value makes $\frac{1}{2}(Z-p)$ an integer.

It is also possible to get a unique structure by excluding the possibility of unattached electrons but allowing the possibility of positrons. The structure is then

$$\tfrac{1}{2}(Z-p')\ \alpha\text{-particles}+(P-2Z+2p')\ \text{neutrons}+p'\ \text{positrons} \quad . \quad . \quad (2)$$

where again $p'=0$ or 1 as before. This is practically the suggestion which Elsasser supports.

Using these expressions, we can trace the changes which take place in the nuclei of radioactive elements during α- and β-ray transformations. The accompanying table shows a typical set of transformations.

	Nucleus from (1)	Nucleus from (2)	Radiation
Ur I	$46\alpha+54n+0p$	$46\alpha+54n+0p'$	
↓			α
Ur X_1	45 54 0	45 54 0	
↓			β
Ur X_2	45 53 1	45 54 1	
↓			β
Ur II	46 50 0	46 50 0	
↓			
Io	45 50 0	45 50 0	

The explanation of the α-ray changes is obvious. The β-ray changes in a radioactive series generally occur in pairs and the pair above shows changes identical with all other pairs of β-ray transformations. If the nuclear contents are expressed by (1), the changes take place in the following reasonable manner :—

$1n \rightarrow 1p+1\beta$ the proton remaining in the nucleus, and $3n+1p \rightarrow 1\alpha+1\beta$ the α-particle remaining in the nucleus.

On the other hand, if expression (2) gives the nuclear contents, then the changes which take place are

$0 \rightarrow 1p'+1\beta$, a positron appearing in the nucleus, and $4n+1p' \rightarrow 1\alpha+1\beta$, the α-particle remaining in the nucleus.

But where do the electron and positron come from in the first change, and how is the alteration in charge to be accounted for in the second change ?

It is interesting to note that the expressions (1) and (2) give lower limits to the mass of an isotope. The minimum value from (1) is $P \geqslant 2Z-p$ and from (2) it is $P \geqslant 2Z-2p'$. It will also be observed that isotopes only differ from each other in the number of neutrons in their nuclei.

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June 3.

Small-Angle Inelastic Scattering of Electrons in Helium

IN the *Physical Review* for May 1, 1933 under "Proceedings of the American Physical Society" appears a note dealing with the small-angle inelastic scattering of electrons by Mr. S. N. Van Voorhis.

We have for some years been investigating this problem in this laboratory using a specially designed apparatus in which very narrow parallel electron beams can be used, and have photographed a very large number of scattered beams in helium which show that at small angles of scattering effects hitherto unsuspected occur. A preliminary note was published by us in the *Proceedings of the Leeds Philosophical and Literary Society* of April, 1933.

It appears, in agreement with Van Voorhis, that a distinct maximum in excitation probability may occur at certain angles and voltages and the photograph here reproduced (Fig. 1) shows very distinctly how considerable the effect may be. It is not confined, as is clearly shown in the electron spectra, to the inelastically scattered electrons, but is shown also rather less obviously by the elastic ones. We at first thought that this maximum was a case of classical diffraction, but closer investigation did not support

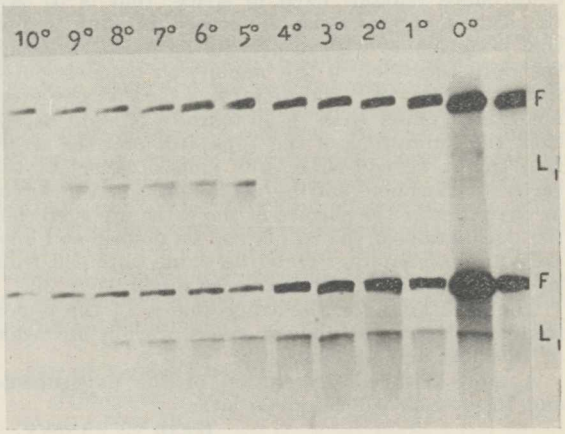

FIG. 1. Magnetic spectra of electrons scattered elastically (F) and inelastically (L_1) at angles up to 10° in helium. Note maxima at 0° and 2°–5°. The values of F in the upper and lower sets of spectra are 150 volts and 190 volts respectively.

this view—particularly as the maximum rapidly closes in to zero as the electron speed approaches 250 volts, while after that the maxima are scarcely discernible either by eye or by photometer. It is probable that this may in part be due to the effect mentioned in the last paragraph of this letter.

We have obtained further evidence also on this point. By using another apparatus in which very fine and narrow beams are produced by a series of minute holes, the probability of excitation of the $(1^1S_0-2^1P_1)$ state of helium at zero angle has been accurately measured over a range of electron energies.

This probability varies from about 1 in 10,000 to 1 in 2,000 over the range of electron energy 50 volts to 400 volts. But using the slits commonly employed by other workers in this field, the measured probabilities are enormously greater—an observation readily explained by the above-mentioned results.

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May 24.

Radio Waves from Outside the Solar System

IN a recent paper[1] on the direction of arrival of high-frequency atmospherics, curves were given showing the horizontal component of the direction of arrival of an electromagnetic disturbance, which I termed hiss type atmospherics, plotted against time of day. These curves showed that the horizontal component of the direction of arrival changed nearly 360° in 24 hours and, at the time the paper was written, this component was approximately the same as the azimuth of the sun, leading to the assumption that the source of this disturbance was somehow associated with the sun.

Records have now been taken of this phenomenon for more than a year, but the data obtained from them are not consistent with the assumptions made in the above paper. The curves of the horizontal component of the direction of arrival plotted against time of day for the different months show a uniformly progressive shift with respect to the time of day, which at the end of one sidereal year brings the curve back to its initial position. Consideration of this shift and the shape of the individual curves leads to the conclusion that the direction of arrival of this disturbance remains fixed in space, that is to say, the source of this noise is located in some region that is stationary with respect to the stars. Although the right ascension of this region can be determined from the data with considerable accuracy, the error not being greater than ± 30 minutes of right ascension, the limitations of the apparatus and the errors that might be caused by the ionised layers of the earth's atmosphere and by attenuation of the waves in passing over the surface of the earth are such that the declination of the region can be determined only very approximately. Thus the value obtained from the data might be in error by as much as ± 30°.

The data give for the co-ordinates of the region from which the disturbance comes, a right ascension of 18 hours and declination of − 10°.

A more detailed description of the experiments and the results will be given later.

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May 8.

[1] Karl G. Jansky, "Directional Studies of Atmospherics at High Frequencies", *Proc. Inst. Rad. Eng.*, **20**, 1920; 1932.

A Simple Hygrometer

THE method described here has been developed to measure the humidity of the air in very small and inaccessible places. The hygrometer is extremely simple, consisting of a piece of paper 1 cm. × 1·5 cm. in size, weighing about 10 mgm. The paper has a hole at one end, by which it can be hung on to a torsion balance and weighed. Paper is a hygroscopic substance, which takes up an amount of water from the air proportional to the relative humidity, irrespective of temperature. The paper used (thin writing paper) increases in weight by 12 per cent when transferred from perfectly dry air to air which is 90 per cent saturated, and reaches equilibrium in 10–15 minutes. The torsion balance used is accurate to one-fortieth of a milligram, and the humidity can be measured accurately to 2 per cent.

The paper hygrometers should be kept in desiccators at 40 per cent relative humidity. If a number are made from one sheet of paper, it will only be necessary to calibrate one of them. The change in weight, after transferring from 40 per cent humidity, expressed as a percentage of the weight at 40 per cent, will be the same for all the hygrometers exposed to any particular humidity.

There are many applications for this method of hygrometry. It is possible to measure the humidity at the surface of a leaf, or among vegetation, without disturbing the air.

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May 26.

Co-operative Industrial Research

THE leading article in NATURE of June 10 on this subject appears to me to be of profound significance. It brings into prominence the fundamental issues in regard to industrial research and the application of science to industry, which are so seldom taken into consideration.

I do not write in any critical spirit, but I feel that the end of the War left us—statesmen, administrators, scientific workers, and the nation at large—obsessed with the idea that the benefits to be derived from the application of science to industry were mainly external to the human mind and purely materialistic. We were very confident then that the so-called rationalisation of industry, the elimination of hand labour, the development of machinery and processes and the standardisation of mass-produced articles, were going to make us all happy and prosperous. A good many industrialists have learned since then that cheapness and efficiency in production are by no means everything; it is what is produced that matters most.

The vital thing about any manufactured product is the purpose it serves in the life of man, not the processes of its manufacture. Consideration of purpose leads to the investigation of design. Design is usually stated to include three factors, beauty, distinctiveness and utility. The relative importance of these factors will vary with the product, but it seems to me that to concentrate almost all industrial progress on utility, which is at present mainly affected by industrial research, may not give the highest true economic values.

At the same time, my experience has been that co-operative industrial research influencing the design of a product has been more appreciated and more readily and evenly utilised by firms of all sizes than research in other directions. The user, to whom the finished product is a design carried out in a certain raw material, has the last word in regard to research on design, but our present organisation of industrial research does not give him much representation on research committees. Again, it is clear that progress in industrial research depends on a scientifically minded consumer, who keeps abreast of developments in design.

I am afraid we have been inclined to look on the consumer as an ignorant or incompetent individual who will take what the manufacturer sees fit to provide. This is far from the truth to-day. Whether we like it or not, the rising generation is imbued with the scientific spirit and insists on absorbing and

applying scientific knowledge. If our system of general education were brought up to date and a more practical and realistic training in science and scientific method given to everyone, it would exert immense pressure for progress upon our industries.

Our present organisation of co-operative industrial research divides industry into compartments. It pre-supposes that an industry in which the processes of production are located in a certain district requires a highly specialised research centre in that district, because the industry is not expected to move or to change over to other products at all readily; and yet we know that these changes are going on.

It seems that the Mellon Institute system of industrial research of the United States, closely associated with our system of universities and colleges, would be better suited to our independent, resourceful, and enterprising British manufacturers in some cases. Such institutes would form the best training grounds for scientific workers entering industry; one could even expect in many industries to find all executives with a scientific training in the long run, and any industrialist who wanted to start up a new local industry could begin by supporting one or two 'fellows' at his local institute. If such a change were brought about, the main work of many of our existing research associations would not alter, but development would occur in many directions now closed to them. It is probable that some unitary industrial research organisations are too small for optimum efficiency. Many administration difficulties would be removed by incorporating the Mellon Institute scheme in our organisation.

These views are purely personal and limited to my own experience, but if any changes are made, full consideration should be given to the Mellon Institute system as a possible alternative to the existing research association system for co-operative industrial research.

W. H. GIBSON.

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Lambeg,
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June 12.

Action of Light upon the Surface Tension of Soap Solutions

IN continuation of my discovery[1] of the "Effect of Light on the Surface Tension of Boys's Soap Solutions" (which may perhaps be designated as the 'Mahajan Effect'), I have now tried different solutions of different soaps and have found that the light has effect on all the soap solutions and it decreases the surface tension, but this decrease varies in amount, depending upon the kind of soap used and the concentration of that in the solution. It is found that the phenomenon is general and is not restricted to Boys's soap solutions only.

Further work on the subject is being done and will be published soon.

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[1] L. D. Mahajan, *Indian J. Phys.*, Calcutta, pp. 147–154, July 31, 1931; NATURE, **128**, 496, Sept. 19, 1931, and **129**, 133, Jan. 23, 1932; *Proc. Indian Sci. Con.*, Bangalore, p. 124, Jan. 1932. See also P. L. du Noüy, NATURE, **128**, 674, Oct. 17, 1931, and **129**, 278, Feb. 20, 1932, and "Surface Tension of Colloidal Solutions, and the Action of Light on Soap Solutions", NATURE, **131**, 689, May 13, 1933.

Colloid Substrate in Photosynthesis

A FEW years ago I showed[1] that mineral arboreal growth results in an almost simultaneous appearance of a compact (tree- and asbestos-like formations) and dispersed ('streamers' and opacity bands) system. Afterwards the range of mineral tree formations was extended from the ferrocyanide and silicate group of salts to calcium, barium, strontium, arsenates, arsenites, stannates, etc.[2] Since then, it has been found that the dispersed system formation is not only specific to all arboreal growth but also invariably precedes it, being evolved in the course of eruption from the membrane protuberances—diffusion points of least resistance. Again, whilst the delicate 'streamers' and opacity bands exist only under carefully controlled conditions, the colloidal particles constituting these and shot out in myriads during the reaction have a much wider range of stability.

A systematic examination of the arboreal growth and its medium by means of a narrow parallel beam from a Miller projecting lamp showed in a striking manner not only the gradual emergence and spread of finely dispersed colloidal matter throughout the medium, but also the remarkable stability of this condition, Brownian movement persisting in tubes after six months.

Here we have a unique case of periodic structures which actually represents a potent source of colloidal matter. Now, the sphere of photosynthetic activity lies not in the inert colloidal magma of the igneous and sedimentary formations, but in the active mineral dispersions based to a large degree on osmosis—mineral tree formations in an aqueous medium (also possibly saline efflorescence on land) playing in this respect an important part. This (and some oxides and hydroxides) in the form of physico-chemical complexes with other inorganic salts, may constitute the primary substrate of photosynthesis in marine surroundings.

MAURICE COPISAROW.

145 Alexandra Road,
Manchester, 16.
May 30.

[1] Copisarow, *J. Chem. Soc.*, 230; 1927.
[2] Copisarow, *Koll. Z.*, **47**, 60; 1929.

Physical Chemistry in the University of Manchester

As senior British chemist, pupil of the first professor of chemistry (1851) of the Owens College, I would protest against the appointment, referred to in NATURE of June 24, p. 902, by the University of Manchester, of a gentleman who is not an Englishman nor in any way connected with us. Physical chemistry receives much attention at our universities; much public money is spent upon it; we have not a few workers of promise, from whom one might well have been chosen for the post. The introduction of a foreign outlook into Manchester is most undesirable, at the present time, in view of the special needs of our British industry, as well as of education.

By its action, the University of Manchester flouts the grave warning given in the penultimate paragraph of the article in NATURE of June 17 (p. 854). It is well known that Manchester was interviewing rising British physical chemists, with a view to an election to a chair, before the German expulsions took place: so that no question of creating an *ad hoc* post has arisen.

HENRY E. ARMSTRONG.

June 26.

Research Items

Slovene Folk-Lore. An account of the folk-lore of the Slovenes, the Alpine Slavs at the head of the Adriatic, based on a study by Prof. Jakob Kelemina of the University of Ljubljana, is given by Miss F. S. Copeland of the same University, in *Folk-lore*, vol. 42, No. 4. Of the former deities of the Slovenes little is known, owing to the fact that since the Frankish conquest under Charlemagne, the country has been under alien domination for eleven hundred years. The Slovenes believed in the following orders of mythical beings :—(1) spirits having their origin in the belief in the human soul or spirit ; (2) elfin beings, inhabitants of the world of Nature (elementals) ; (3) demons, representing the untamed forces of Nature ; (4) a lord of life and ruler of the heavens, with his spouse, a being of the demoniacal order. They believed that the universe was the work of the lord of heaven. In the end these mythical beings assumed human features and became national heroes, around whom gather the reminiscences of the people. The spirit is independent of the body and leaves it during sleep, embarking on adventures of its own. After death, the spirit survives and may take on an independent entity. With these spirits are classed other beings of a definitely superhuman order, who are compelled to spend part of their time in a torpor akin to sleep. These are either 'good' or 'evil'. To those whom he protects, Kresnik, the supreme being, is he who drives away evil spirits ; to others he himself is an evil spirit ; though as a matter of fact, every spirit has its good and evil aspect. The supreme being of the ancient Slavs, Svarog, is known to the Slovenes as Božic, the Little God, that is, the young sun at the winter solstice. Various customs connected with the lighting of the midsummer fires are derived from the ancient worship of the Slovene gods. Krasniki, who are typical tribal gods, are friendly to man, while the Vedomci are hostile.

Metabolic Products and Tuberculosis. To obtain information regarding the mechanism of natural immunity, recourse is usually had to the complex substances of the fluids and tissues of the organism, and comparatively little is known of the importance of simple metabolic products to the course of infections. In a paper read by Prof. Pietro Rondini before the Reale Istituto Lombardo di Scienze e Lettere on December 1 and published in the *Rendiconti* (65, Parts 16–18), the effects produced on experimental tuberculosis of the guinea pig by injection of uric acid, creatine, and histamine, are described. Mild tubercular infection is invariably aggravated to some extent by uric acid, whereas creatine exerts an attenuating influence. Histamine exhibits no marked action on the course of the infection, but the tuberculous guinea pigs, particularly during the initial phases of the disease, appear more than normally sensitive to the acutely toxic action of histamine administered endoperitoneally (histamine shock).

Remarkable Japanese Fly. In *Annotationes Zoologicæ Japonenses* (13, 559–566, pl. 34, 1932), Mr. Masaaki Tokunaga describes a new genus and species of Diptera based upon six examples taken along a torrential stream in Kyoto. This new type (*Nymphomyia alba*) has been discussed with English and American specialists and it seems very likely that it represents a hitherto unknown family to which the name Nymphomyiidæ is given. The head is prognathous, there are no trophi and the compound eyes are contiguous ventrally : the antenna are 5-jointed and of the brachycerous type. The abdomen is extremely elongated and 9-segmented while there are no spiracles on either the thorax or the abdomen. The legs are characterised by the extremely elongated coxæ and trochanters. The wings are longer than the whole body and are fringed with long setæ very much as in Thysanoptera, with the venation very much reduced : the halteres are also very long. In its general characters this remarkable creature seems to bear a remote likeness to the Psychodidæ and Cecidomyiidæ. It is evidently a member of the series Nematocera, although the antennæ are totally different from the prevailing type among that group. The author promises more detailed studies that are to be published in the Memoirs of the Kyoto Imperial University, where he is an assistant in entomology.

Frost Tolerance of the Foliage of Potatoes. While in Great Britain damage by frost occurs only in spring, considerable loss of yield is suffered in Russia through early autumn frosts destroying the foliage before maturity. S. M. Bukasov (*Bull. App. Bot. Genetics and Plant Breeding*, Leningrad, 2, No. 3 ; 1932) and G. M. Kovalenko (*Plant Industry in U.S.S.R.*, Leningrad, No. 3, 1932) record considerable variation in the tolerance of many wild and cultivated species and varieties—collected from many countries. While the European cultivated types (*Solanum tuberosum*) were damaged by frost, species such as *Solanum Juzepczukii*, Buk., cultivated by certain Indians of South America, and certain wild species, for example, *S. Bukasovii*, Juz., showed great tolerance. In some forms the stem and leaves remained green even after the plants had been covered for some time with snow. It was found that, within a species, similar morphological forms may differ in this respect. This work is part of a scheme for the synthetic breeding of varieties of potatoes suitable for various parts of the U.S.S.R.

Diœcism in Maize. A biological phenomenon that marks a point of progress in evolution is described by the Director in the fifty-fifth report of the Connecticut Experiment Station (Bulletin 337). The maize plant is normally monœcius, the two sexes being distinct although occurring on the same plant, but by means of crossing two unisexual freak plants which were noted in the field, a diœcious variety that breeds true has been obtained; that is, the separation of the two sexes on to separate plants has been experimentally achieved. It seems possible that this may illustrate how the phenomenon of diœcism has arisen in other plants under natural conditions.

Lavas of Mauritius. In 1931 Prof. S. J. Shand made a journey to Mauritius to investigate the lavas and the supposed occurrence of chloritic schist (*Quart. J. Geol. Soc.*, 89, 1–13 ; 1932). The 'chloritic schist' turned out to be a trachyte with platy structure and thus any support it appeared to offer to the Wegener hypothesis can no longer be claimed. The lavas of the island are mainly basalts, some rich in olivine and others almost or quite olivine-free. No fel-

spathoids have been detected, but some of the basalts have nephelite in the norm. Soda-trachyte was found at two localities and is regarded as a differentiate from basaltic magma. This rock holds normative nephelite and approaches phonolite in composition. The problem of the derivation of trachyte or phonolite from basaltic magma is discussed with special reference to the hypothetical reaction: plagioclase + olivine $\rightleftarrows$ nepheline + pyroxene. Normally, the reaction proceeds towards the left, but if under certain conditions it should proceed towards the right, a basalt of pacificite or tephritic type would result. Prof. Shand considers that the streaming of magmatic gases towards the roof of the reservoir facilitates the separation of residual liquors of trachytic or phonolitic composition. He points out that as yet we do not know what causes basaltic magma to take the pacificite direction in crystallising.

Marie Byrd Land, Antarctica. During the American Antarctic Expedition of 1928–30, Admiral R. E. Byrd, in a flight to the north-east from his base at the Bay of Whales on the Ross Barrier, discovered Marie Byrd Land to the east of Edward Land, but no landing on the new territory was possible. From the air photographs available, Commdr. H. E. Saunders has constructed a map of the new discoveries which is published in the *Geographical Review* for April. The map must be regarded only as a reconnaissance survey showing the nature of the country and the position of the principal landmarks with sufficient accuracy for use on a flight in the future. There was little ground control and the photographs could be oriented only by means of shadows from the sun. Scott's work in this direction ended with a sight of the Alexandra Mountains. Scott's nunataks in lat. 77° 13′ S., long. 153° 20′ W. at the north of this range were visited by the Norwegian Prestrud in 1911 and the Japanese Shirase in 1912. These peaks were sighted and used as ground control. Beyond to the east, Byrd found a deep indentation in the coast-line and then an area which is probably shelf ice behind which lie the peaks of the Edsel Ford Range. These are estimated to rise to 2,000–4,000 ft. Their structural affinities are quite unknown but it is noteworthy that the peaks lie in a north and south direction between long. 142° and 144° W. Byrd's flight turned in about lat. 75° 30′ N., long. 145° W. At that point there were no definite land-marks to the east, but open water was not far off to the north.

Electron Diffraction and the Condition of Metal Surfaces. A paper by L. H. Germer (*Phys. Rev.*, May 1) discusses the reason why no diffraction rings are formed when electrons are scattered from polished metal surfaces. G. P. Thomson and others have suggested that such surfaces are covered by an amorphous layer. Germer finds that diffraction rings are formed after the polished surface has been scratched with emery paper, particularly when the scratches are at right angles to the plane of incidence of the rays. Diffraction patterns were not obtained from a copper wire drawn through a good die, but were obtained when the die had imperfections which led to ridges being drawn in the wire. In the latter case the ridges had undergone as much cold working as the remainder of the surface and might be expected to be amorphous on the view mentioned above. Furthermore, even etched metal surfaces do not give patterns when they are smooth and show metallic lustre. Germer suggests that the diffraction rings are in all cases formed by transmission through thin ridges of metal. This explains why they do not show a marked effect of refraction which is predicted by theory if the electrons pass in and out through the same surface. The failure to observe diffraction patterns with polished surfaces may be explained if the surfaces consist of portions inclined to one another at small angles. The effect of refraction is then to broaden the rings and cause them to merge into one another.

Astronomical Topics

Astronomical Notes for July. Venus, Mars and Jupiter are evening stars, but too low in the west for convenient observation. Saturn, in Capricornus, is approaching opposition, and is observable for most of the night. Uranus is near the eastern border of Pisces, and may be observed before dawn. Only one occultation is observable in London under favourable conditions; a star of magnitude 6·8 reappears at 2.59 a.m. on July 20, at angle 276° from the north point through the east. Add one hour to the time to reduce to Summer Time.

The Expanding Universe. The *Observatory* for June gives a summary of an address on this subject, given by Prof. de Sitter at the May meeting of the Royal Astronomical Society. He observed that many astronomers are now disposed to abandon the long scale of millions of millions of years for the past duration of the stars, in view of the shorter scale suggested by the rapid recession of the spiral nebulæ. He considers that the longer interval is needed to give time for stellar evolution, which is strongly supported by the discovery of the relation between mass and luminosity. He thinks that the difficulty can be surmounted by supposing that the stars are older than the galaxies in their present configurations. Apparently the phenomena of nebular rotation can not persist indefinitely, but must have begun not more than a few thousand million years ago. Sir Arthur Eddington used the same argument in his Halley lecture on the rotation of the galaxy. The estimates of the past duration of the earth also give a period of a few thousand million years, thus suggesting a common origin both of the planetary system and of galactic rotation. His suggestion was that the spirals had previously been moving inwards, and were all near the common centre at the epoch referred to. There need not have been intense crowding; even if a million galaxies occupied the space now taken up by one, the average mutual distances of the stars would still be about a hundred thousand times their diameters. But obviously close encounters would have been much commoner than under present conditions, so that solar systems would not be such rare freaks as some cosmogonists suppose them to be. The same kind of action, but on a much larger scale, may account for the rotation of the galaxies, and their spiral form. The general idea of such an appulse of galaxies has been suggested earlier, but Prof. de Sitter gave fuller details both about the probable date of the appulse and about its effects on the forms of the spirals.

The National Physical Laboratory

ANNUAL VISITATION

ON June 27 the General Board of the National Physical Laboratory made its annual inspection of the Laboratory. As is customary on this occasion, a large number of visitors were present, including members of scientific and technical institutions, Government departments and industrial organisations. They were received by Sir Frederick Gowland Hopkins, president of the Royal Society, chairman of the Board, the Right Hon. Lord Rayleigh, chairman of the Executive Committee, and the Director, Sir Joseph E. Petavel.

In the Compressed Air Tunnel of the Aerodynamics Department a study is being made of the performance of a number of commonly used aerofoils, to secure data for comparison with results obtained with similar aerofoils in the American variable density tunnel and comparison with full-scale tests in flight. For the latter purpose, any of the aerofoils, by the addition of a fuselage and tailplane, can be converted into a complete model of a parasol monoplane with which full-scale tests are being undertaken.

The research on buffeting of aeroplane tails has been continued and a number of aerofoils of different sections have been examined to ascertain the nature of their wakes near the stalling angle. It has been found that the buffeting is very similar for all the aerofoils, provided they are set at angles of incidence similarly related to their stalling incidence. A study is being made of the buffeting characteristics of wing body combinations. The effects of undesirable combinations were demonstrated.

An important investigation is concerned with the stability and control of aeroplanes at low flying speeds. A study is being made of the effect of wing tip shape (including slots and other devices attached at the tips) on the rolling and yawing properties of model aerofoils. The data for the former are being derived from measurements made for a series of wing tip shapes, on a model half wing in one of the wind tunnels, and for the latter from measurements made on the whirling arm. In the investigation of spinning motion the importance of adequate fin and rudder area in preventing a spin and in assisting recovery from a spin, and the necessity for preventing shielding of the rudder and fin by the tailplane have been established. Some unsolved problems remain in connexion with the behaviour of slots and interceptors during a spin. Experiments are being made with the spinning balance to obtain further data.

The equipment of the Department has been increased by the installation of a high speed open jet wind tunnel of the return flow type with an elliptic jet 9 ft. × 7 ft. The tunnel is expected to give a wind speed of about 200 ft. per second with a considerable saving in power expenditure.

In the Engineering Department, fatigue experiments on single crystals have been extended to specimens consisting of more than one crystal, to determine how far the behaviour of crystalline aggregates can be correlated with that of the single crystal. Several specimens each consisting of two crystals of aluminium but with the crystalline boundaries differently orientated to the axis of torsion have been tested under alternating torsional stresses. The tests indicate that a crystalline boundary is capable of affording considerable support to the crystals which it separates. In the sphere of corrosion fatigue, a study of the behaviour of specimens composed of two large crystals of aluminium subjected to alternating torsional stresses in a slow stream of tap water has shown that the boundary has no effect on the corrosion.

An investigation for the Steel Structures Research Committee of the Department of Scientific and Industrial Research into the reliability of electric welding for steel structural work is in progress. The work has included mechanical tests on a large number of electric arc welded test pieces prepared by various manufacturers, and corresponding tests on the properties of the actual weld material. Rotating bending fatigue tests show that the fatigue resistance of specimens of the weld metal is appreciably less than that of structural steel of the same tensile strength. Specimen test pieces and some results of these investigations were exhibited.

In the research on the creep of materials, changes in the elastic and hysteresis properties of materials during creep have been studied. Observations have been recorded of negative creep (contraction) after full or partial removal of the load. The work has been extended to creep under torsional and compressive stresses.

The principles underlying the action of the injector have been investigated. Attention is being given to the performance of a high speed jet used as an extractor, in view of the possible application of the injector to lifting fluids carrying solids in suspension. The examination of the airflow is carried out optically by shadowgraph methods, smoke being injected into the high-pressure air before this leaves the nozzle. An interesting exhibit was an application of the injector in the construction of a model high-speed wind tunnel with which air speeds up to 970 ft. per second have been obtained.

On behalf of the Aeronautical Research Committee a joint investigation has been carried out by the Engineering and Physics Departments, using different methods, on the heat of formation of nitrous oxide, a knowledge of which is required in connexion with research on internal combustion engine problems. In the former Department, measurements were made with a bomb calorimeter of the adiabatic type using an explosion method, and a value of 19·7 kgm. cal. per gram molecule was obtained. In the Physics Department, a 'flame' method was adopted in which a jet of the gas was burnt in an atmosphere of carbon monoxide in an adiabatic calorimeter; this method yielded a value of 19·5 kgm. cal. per gram molecule.

In the Heat Division of the Physics Department, several investigations for the Food Investigation Board were in progress. Apparatus has been constructed to determine the rate of evaporation from a moistened surface; this rate depends on a number of factors, including vapour pressure and air velocity. Measurements were made at various wind speeds of the difference between the water supplied to a linen cloth covering the surface of (1) a circular cylinder, (2) a nonagonal prism mounted vertically in a wind tunnel, and that collected as excess in a given time. Measurements with the prism indicated that considerably more evaporation occurs from the surfaces

facing upstream and downstream than from those at the sides.

Recent developments in refrigeration have emphasised the need for data on the thermal properties of meat; a method has been devised of measuring its thermal diffusivity. The thermal conductivity is measured by the total immersion of a small plate apparatus in acetone cooled with solid carbon dioxide. The specific heat is determined by immersing a known mass of meat at a given temperature in solid carbon dioxide and weighing the amount of the latter sublimed.

Work on the heat-transfer between metal pipes and an air stream has indicated that the heat loss per foot run is less from pipes situated along the air stream than from pipes set transverse to the stream. Eddy currents set up before the air stream impinges on the pipes are found to produce a considerable increase in the heat loss.

Research has been carried out for the British Electrical and Allied Industries Research Association on the thermal diffusivity of soil. Periodic fluctuations of temperature, as nearly as possible sinusoidal, are produced in the soil by regulation of the heating current in a buried sphere. The decay in amplitude of the temperature waves with distance from the sphere provides the data required.

In the Radiology Division, X-ray spectrometry has been applied to the detection and measurement of internal strain in metals. It has been found that cold drawing and cold rolling produce lattice distortion followed by selective crystal orientation. The behaviour of X-ray generators has been investigated; a study has been made of the relation between the applied voltage and the output of X-ray tubes. Oscillographic records have been obtained of the current and voltage wave-forms of various circuits for X-ray work, including constant and pulsating voltage generators. Results have indicated the factors of importance in the design and use of X-ray generators.

In the Sound Division an experimental investigation of the rates of decay of tuning forks, used for otological testing, has been made on behalf of the Royal Society of Medicine; routine tests are now undertaken by the Laboratory on this type of fork. The tests are designed to simulate those in common use by otologists in deafness tests; the rate of decay is measured with a microphone, connected to suitable apparatus, both in free air and with the base of the fork connected to an artificial substitute for the mastoid bone of the skull.

In the Optics Division, the problem has been investigated of evaluating, on the international system of colorimetry adopted at the International Commission on Illumination in 1931, small differences in nearly identical colours. A differential colorimeter evolved in the Department for this work was exhibited. Improved containers for the standard liquid filters used in colorimetric measurements were also shown. These ensure that the liquid layer is of the specified thickness to a high degree of precision; at the same time, loss of volatile constituents is prevented.

In the Metallurgy Department, investigations are in progress for the Metallurgy Research Board of the Department of Scientific and Industrial Research on the behaviour and effects of dissolved gases in the casting and solidification of steel and aluminium and its alloys, with the view of producing sound castings free from porosity. A study is being made of the solubility of gases in the metals with special reference to hydrogen and nitrogen in the case of steel and iron, and to hydrogen in the case of aluminium and its alloys. The metal is melted *in vacuo* in a constant volume enclosure; the gas is then admitted, and its absorption is measured by means of a graduated burette, the temperature being maintained approximately constant.

An investigation is being made into the factors which govern the solution of gases in molten aluminium and its alloys. The work has suggested that the surface film consisting mainly of oxide, which covers the molten metal, may exert considerable influence by hindering the free passage of gas into or from the metal. A study of the formation and properties of these films has been undertaken. The method adopted is similar to that used for the solubilities of gases, oxygen being admitted to the vacuum chamber under definite conditions. In the study of the films, the new apparatus for producing diffraction by a beam of electrons is expected to prove useful.

Attention has also been given to the effects of hydrogen content and casting conditions on grain size. In both chill and sand cast billets, some dissolved hydrogen is found to reduce the grain size. The influence of mould dressings has also been examined, and a flaming dressing which gives off gas when in contact with the aluminium is found to produce a very fine grain size.

Research for the British Non-Ferrous Metals Research Association has established the importance of casting conditions on the distribution in copper of impurities such as nickel, arsenic, antimony, bismuth, oxygen and their compounds, and hence on its rolling behaviour and mechanical properties. A study is being made of the distribution of impurities in large works ingots, and etched structures of sections of works ingots were exhibited. In this work the methods of microchemical analysis have proved valuable, since these are sensitive to very minute quantities of the impurities. The methods are being extended to quantitative analysis of small samples only.

In the Metrology Department, determinations have recently been completed of the yard and metre in terms of the wave-length in air and *in vacuo* of the red radiation of cadmium. Air conditioning apparatus is provided to ensure freedom from moisture and carbon dioxide of the air between the plates of the Fabry-Perot etalon.

In connexion with the maintenance of the standard of time, the vibration clock, the operation of which depends upon the longitudinal vibrations maintained in an elinvar bar by electrostatic forces, has been compared with the Shortt clock. The comparison has shown them to be in agreement within plus or minus two hundredths of a second over a period of six weeks. The precision of measurement of the standards of length and time as well as of mass is now tending towards the order of about one part in 10^8.

In the High Voltage Division of the Electricity Department, research is in progress by sphere gap methods on the characteristics of high voltage impulses applied to short lengths of transmission line. A ten stage impulse generator constructed for this work and yielding voltages up to one million was exhibited. Attention has also been given to the accurate measurement of high voltages by capacity methods, and a shielded vacuum condenser utilised in this problem was shown.

In the Electric Standards Division, a number of standard resistance coils designed to have the greatest possible stability have been constructed. The coils, which are to be used at the temperature of melting ice, are made of platinum wire wound on fused quartz formers, and are hermetically sealed in tubes of fused quartz. A study has been made of the magnetic properties of materials, generally classed as non-magnetic, which are commonly used in the construction of such coils. The investigation has established that marble, fused quartz and glass are all slightly diamagnetic, while porcelain is slightly paramagnetic.

In the Electrotechnics Division, a new four-terminal, non-inductive resistor has been constructed for high precision work with alternating currents. Adjustments are provided for reducing the effective inductance to a very low value.

An automatic mechanism for counting the disc revolutions of electricity meters during test was shown. An electric clock is started at the same time as the revolution counter and stopped after any desired number of revolutions has been completed. The arrangement is operated by a photoelectric cell into which light is reflected once in each revolution from a mirror attached to the rotating element of the meter.

In the Photometry Division, methods of testing signal lenses for use with railway and road traffic signals for conformity with a British standard specification were demonstrated. Measurements are made of the transmittance of the lenses and also, in the case of road traffic signals, of the light distribution from the lenses. Apparatus has also been installed for the determination of the time-variation of eye sensitivity after exposure of the eye to a high-glare source. This work is complementary to work which has already been carried out on the effects of a steady glare source on eye sensitivity. The results are being applied to a study of glare effects with motor-car headlights. In the course of measurements on pupil size, made during the work, the luminous efficiency of rays entering the eye pupil at different points has been found to vary; hence the apparent brightness of a source as seen by the eye is not proportional to the pupil area as is generally assumed.

In the Radio Department, a new transmitting station has been installed for work in connexion with the ionosphere. The equipment covers a continuous range of wave-lengths from 50 m. to 1,000 m. Provision is made for key signalling and for various forms of modulation, and the apparatus is equipped with an automatic device for varying the frequency of the emitted waves in any specified manner or for emitting the waves in periodic impulses of short duration.

Investigations are in progress on behalf of the Radio Research Board into the production and properties of short waves. A new type of valve for use as an electronic oscillator producing waves less than one metre in length, and possessing increased efficiency and flexibility in the control of wave-length, was exhibited. A study is being made of the propagation of wave-lengths in the neighbourhood of 1 m. with special reference to the determination of the electrical constants of the ground at very high frequencies, and to the mechanism of reflection of electric waves at an imperfectly conducting surface. In this work, a small transmitter is mounted vertically above, and at a fixed distance from a receiver; measurements are made of the interference effects between waves received directly by the receiver and those reflected to it from the ground.

Another exhibit was an apparatus used in an investigation of the electrical properties of soil for wave-lengths from 30 m. to 3,000 m. in connexion with the propagation of waves along the surface of the earth. Measurements of the effective resistance and capacitance of a condenser containing the soil permit the dielectric constant and specific conductivity of the latter to be determined; measurements are made simultaneously of the moisture content. Experiment has shown that the conductivity of soil containing moisture of an amount equal to that usually met with in garden soil is more than a thousand times greater than that of dry soil.

A stable radio frequency amplifying circuit, developed in the Department, for triodes was shown. Amplifying circuits employing screen-grid valves have the disadvantage that they give distortionless magnification only over a very limited range, and further, that they are unsuited for cases where sharp tuning is required, owing to their instability when used with high efficiency coils. The circuit exhibited is completely stable even with coils of the highest efficiency. Amplification equal to that given by a good screen-grid valve can be obtained; and under suitable conditions, it is strictly linear with voltage output.

In the William Froude Laboratory research is being undertaken into the problems of hull form and propeller design, position and revolutions, in an endeavour to determine, for various types of twin screw ships, the hull form possessing minimum resistance associated with the highest propulsive efficiency. The tests are made with self-propelled models, and in the Alfred Yarrow Tank an example was shown in the form of a model of a 600-ft., 21-knot, twin-screw vessel. Measurements of the power required to drive the model, its speed and the thrust of the propellers are automatically recorded during the test. The steering and manœuvring qualities of vessels is another problem engaging the attention of the department. A model of a twin-screw coastal vessel equipped with apparatus for measuring its manœuvrability and the power required by the steering engine was exhibited.

University and Educational Intelligence

BIRMINGHAM.—At a degree congregation held on July 1, the Chancellor (Viscount Cecil of Chelwood) presiding, the degree of D.Sc. was conferred on Mr. A. R. Bowen, for published researches on petroleum and synthetic oils, and *in absentia* on Mr. F. J. Warth for papers on absorption of lime by soils, phosphate requirements of soils, and on nutrition and feeding of animals.

The following appointments have recently been made: Mr. W. J. Rees, assistant lecturer in botany; Dr. C. W. Forsyth, lecturer in mental diseases; Mr. C. F. V. Smout, assistant demonstrator in anatomy.

LEEDS.—Dr. E. A. Spaul has been appointed professor of zoology in succession to Prof. W. Garstang. In 1921, Dr. Spaul joined the staff of the Birkbeck College, London, as assistant lecturer, became senior lecturer in 1924, and in 1930 was appointed to his present post of university reader in zoology. He has carried out research work in experimental,

systematic, cytological and histological branches of zoology and is well known for his series of researches on the pituitary gland.

Prof. Frank Smith, professor of education at Armstrong College, Newcastle, has been appointed professor of education in succession to Prof. Strong as from October 1.

Mr. A. T. King has been appointed professor of textile industries, in succession to Prof. A. F. Barker. In 1907–11 Mr. King was demonstrator and junior lecturer in chemistry at the University of Leeds, and for the ten succeeding years held appointments on the academic staff of the Imperial College of Science and Technology, London. In 1921, he was appointed chief chemist to the Wool Industries Research Association, Torridon, Headingley, Leeds, and as first holder of the office, undertook the organisation and development of the chemical side of the Association's work. He has carried out research and experimental work on a variety of problems which have arisen in connexion with the textile industries, and has had, in addition, a wide experience of processing of textile materials under mill conditions.

The following appointments, among others, have also been made recently: Prof. H. Collinson, professor of clinical surgery, to be professor of surgery and head of the Department of Surgery, as from the beginning of next session, in succession to Prof. J. F Dobson; Mr. A. Richardson, to be professor of clinical surgery, as from October 1; Mr. E. R. Flint, to be director of surgical research, in succession to Mr. L. R. Braithwaite.

LONDON.—Prof. L. N. G. Filon has been re-elected vice-chancellor for the year 1933–34.

The following appointments have been made: Dr. R. A. Fisher, Rothamsted Experimental Station, to be University professor of eugenics at University College; Mr. S. R. K. Glanville, assistant keeper of the Egyptian and Assyrian antiquities at the British Museum, to be University reader in Egyptology at University College.

The title of University professor has been conferred on the following in respect of posts held at the Colleges indicated: medical entomology, Mr. P. A. Buxton (London School of Hygiene and Tropical Medicine); pharmacology, Dr. J. H. Burn (College of the Pharmaceutical Society).

The degree of doctor of laws *honoris causa* was conferred on the following in connexion with the laying of the foundation stone of the new University buildings on June 26: the Right Hon. Viscount Grey of Fallodon, Chancellor of the University of Oxford; the Right Hon. Stanley Baldwin, Chancellor of the University of Cambridge; Sir Hassan Suhrawardy, Vice-Chancellor of the University of Calcutta; His Excellency the Hon. R. W. Bingham, United States Ambassador, who represented the University of North Carolina at the ceremony; Sir Maurice Jenks, Lord Mayor of London, 1931–32; Mr. Ernest M. Dence, chairman of the London County Council.

AT the House of Lords on June 29, Lord Jessel asked leave to withdraw the University Spurious Degrees (Prohibition of Use and Issue) Bill, on account of faulty drafting, and to introduce a new Bill, the University Degrees Bill, which makes provision with respect to the unauthorised grant, issue, use, or assumption of degrees. Leave was granted and the new Bill read a first time.

Calendar of Nature Topics

First 'Buchan Warm Spell'

July 12–15. In his investigations into the annual variations of temperature in Scotland, Dr. A. Buchan found a maximum between July 12 and 15, which may be said to mark the 'height of summer'. The mean daily temperatures at Greenwich from 1841 until 1930 also rise to a maximum on July 14 and 15. This is not to be taken as a regularly recurring warm spell, however, but only as the peak of the curve representing the long-period average of the annual variation of temperature; there have been some very hot days about this time, but in many years the temperature is moderate.

July 15, St. Swithin's Day, is popularly said to govern the weather of the succeeding forty days. Actually, the greatest heat of summer is often followed by a period of unsettled, thundery weather, but statistics show that the tendency for rain during this period is independent of whether any rain falls on July 15, and of course in England it is exceedingly rare for rain to fall in the same locality on each of forty consecutive days.

Cod Fisheries and Sea Temperatures

On July 8, 1929, the cod-traps at Raleigh, Newfoundland, in the region of the Strait of Belle Isle, contained a great catch of fish, although on the previous day they had been empty. For a fortnight before that date the sea-temperature, as recorded on a neighbouring beach, had been very low, ranging from 1·9° to 8·6° C., but showing a gradual rise; on June 8 it rose to 10·7° C. From that time the fishery progressed satisfactorily until July 31, when it ended as abruptly as it had begun. The four days following the departure of the cod show temperature records in the sea ranging from 12·5° to 14·3° C.

The cod-traps lie at the bottom, and the beach records do not give the actual temperature of the bottom water, which as a rule is a few degrees less, but the correlation is suggestive, and if established would show that surface temperatures might be a useful guide to cod fishermen. The indications are that the cod keep in touch with a bottom temperature ranging from 6·2° to 10·8° C., the biggest catches being made between temperature limits of 8° and 10° C. (G. F. Sleggs in *Rep. Newfoundland Fish. Res. Com.*, vol. 1, No. 4, p. 99; 1932). The biological linkage between cod and cold currents is thought to be through the effect of sudden changes of temperature upon the plankton, so that large numbers of dead ctenophores and jelly-fish accumulate at the place of impact of the cold current and afford food supplies for other organisms.

But perhaps there is a physiological limit as well as a food limitation, for during the cruise of the *Cape Agulhas*, cod were most plentiful at temperatures above 3° C., but scarce below that limit even at neighbouring stations. For example, good supplies were caught at Stations 52 and 60 (temperatures 7·5° C. at surface to 6·4° C. at bottom in 30 metres; and 9·9° C. at surface to 3·3° C. at bottom in 50 metres), whereas at Stations 54 and 62, quite close at hand, cod were scarce (temperatures 6·5° to 0·3°, and 13·7° to 0·4°). Still more clear was the implication of the result in the Bay of Islands region: fish could not be caught on the bottom, where the temperature was 0·9° C., but 10 metres off the bottom the temperature was 3·4° C. and cod were easily caught by jigger.

Re-appearance of a Seal once thought to be Extinct

In July, 1880, the San Diego newspapers recorded the arrival of the schooner *Ellen* with a catch of 400 seal-skins, and in July, 1881, the sloop *Brisk* brought in a cargo of seal-skins. These are amongst the last newspaper records of the destruction of the fur seal of the Californian Islands, and they suggest that one of the causes of the disappearance of the seal was its slaughter during the breeding season when, in June and July, it resorted to the islands for the birth of the young. Between 1810 and 1812, 73,402 fur seals were killed at the Farallon Islands; between 1876 and 1892 not fewer than 5,575 were taken at Guadalupe and San Benita Islands; but in 1892 when C. H. Townsend made a survey of Guadalupe, he saw only seven fur seals, none of them on land.

There was no information about the Californian fur seal subsequent to 1894, and it was thought to be extinct. Then in 1928 two fur-seals were captured at Guadalupe and brought to the San Diego Zoological Garden, where they were discovered to be the lost species, *Arctocephalus townsendi* (C. H. Townsend, *Zoologica*, 1931, p. 443). It bears a close likeness to the fur seal of the Pribilof Islands, but the head is flatter and the snout longer and more pointed.

Fishermen's records of fur seals seen near Santa Barbara Islands in summer must relate to the Californian species, for the northern fur seal makes for the Bering Sea at that season. But, all told, the remnant of the Californian fur seal numbered only about sixty individuals when they were discovered in 1928. Their safety and their increase depend very largely upon the effectiveness of regulations made by the Government of Mexico, for Guadalupe unfortunately lies some fifty miles south of the limit (thirtieth parallel of north latitude) fixed by the convention for the protection of the northern fur seal.

Hay Time

With some seven million acres of grass mown for hay each year in Great Britain, hay-making must be one of the most conspicuous farm operations from June until August. Early districts and those with high quality in view begin in June, the upland areas and farmers who are mainly interested in bulk being later.

The rules for hay-making laid down in the older books on agriculture now make strange reading. So late as 1855 in Morton's "Encyclopædia" we find the following sequence of operations. Mow from sunrise to sunset, one man cutting 1–1½ acres per day. Shake out when the dew is off by men and women using forks. Turn in the heat of the day, and run up into windrows before night, or into small cocks if the weather is doubtful. Throw out the following morning and run up into cocks again at night. The following day the cocks are opened up to complete the drying process and the hay is finally loaded and put into stack. Such was the programme when conditions were favourable; in catchy weather a tremendous amount of hand work must have been necessary to save the crop. The only implement mentioned in connexion with hay-making at this period was the horse-drawn tedder which was said to do the work of 12–15 hay-makers.

On mechanised farms at the present day tractor-drawn mowers cut the crop, while hand forks and rakes have given place to side-delivery rakes. Windrows are collected mechanically and swept bodily to the stack by horse or tractor power. Alternatively, the hay may be elevated mechanically into the wagons direct from windrows. Even stacking is mechanised, the loads of hay arriving at the stack being raised bodily by hoisting gear. The result has been a great speeding up of the work, a much higher output per man, and a degree of independence of the weather which the earlier farmers never enjoyed. At the same time the industrialised appearance of a modern hay field is in strange contrast to the densely populated meadows characteristic of the summer countryside in former years.

Societies and Academies

DUBLIN

Royal Irish Academy, May 22. C. H. ROWE: Characteristic properties of certain systems of paths in a Riemannian space. It is shown how certain systems of paths which have special relations to the metric of a Riemannian space may be characterised by considering curvature properties of the sub-spaces that can be generated by means of curves of the system passing through an arbitrary point. W. B. MORTON: Some permanent arrangements of parallel vortices and their points of relative rest. Three vortices at the corners of an equilateral triangle form a permanent configuration whatever be their strengths. For four at the corners of a rhombus there must be a certain ratio, depending on the shape, between the equal vortex-strengths at the ends of one diagonal and those at the ends of the other. For each permanent shape there are filaments of liquid which retain constant positions relative to the rhombus, their number and distribution varying with the shape. P. G. GORMLEY: The wave equation corresponding to a given Hamiltonian. Weyl's formula is verified by considering that the solutions of the wave equation represent probability functions.

PARIS

Academy of Sciences, May 22 (*C.R.*, 196, 1553–1632). LÉON LECORNU: Funicular surfaces. HENRY LE CHATELIER: The law of displacement of chemical equilibrium. The author has stated this law at different times in forms which he regarded as equivalent. The original enunciation given in 1884 is exact, but a later statement, at the time considered as equivalent, is not exact. CAMILLE MATIGNON, HENRI MOUREU and MAURICE DODÉ: The rôle of the temperature in the isomerisation of the butylenes in the presence of alumina. The ratio of 1-butene to 2-butene when prepared by the catalytic action of alumina on butyl alcohol depends on four factors: the effects of acid impurities in the alumina, the temperature, the modification of the catalyst by heating, time of contact. Of these, the first is the most important. L. CAYEUX: The hypothesis of the vegetable origin of the Palæozoic calcium phosphates. The author regards the presence of substantial proportions of carbon in the calcium phosphate deposits of Palæozoic age as indicating an important contribution of Algæ to their formation, and, in consequence, attributes to these deposits an essentially plant origin. RENÉ MAIRE and GEORGES MALENÇON: The 'belaat', a new disease of the date palm in Algerian Sahara. This disease is analogous to that of the Indian palm tree studied by Butler and shown

to be due to *Phytophthora palmivora*. The parasite, the study of which is being continued, is probably different. ANTOINE APPERT : The rôle of the α condition in certain questions connected with the notion of compact ensemble and the maximum of a functional defined on an abstract ensemble. F. E. MYARD : An integrating apparatus for the measurement of areas situated on any surfaces. J. DUFAY and H. GROUILLER : The spectral study of the polarisation of the solar corona during the total eclipse of the sun on August 31, 1932. In the whole of the region of the spectrum examined, the light polarised is nearly independent of the wave-length. G. DÉCHÈNE. The discontinuities of the contact potential of a semi-conducting substance and a metallic electrode. P. DONZELOT and J. DIVOUX : The use of diodes for the amplification of continuous currents. MME. IRÈNE CURIE and F. JOLIOT : The origin of positive electrons. N. STOYKO and R. JOUAST : Anomalies in the propagation of short radioelectric waves. A discussion of the possible causes of receiving double signals with short waves. In certain cases the use of short waves for the determination of longitudes may give rise to serious errors. G. DÉJARDIN and MLLE. R. SCHWÉGLER : The photoelectric properties of magnesium. The films were obtained by two methods—by volatilising the metal in a high vacuum and by cathodic sputtering—and both gave satisfactory results. RENÉ AUDUBERT : The mechanism of the action of light on electrodes photosensitised with copper salts. The photoelectrochemical theory, based on the photolysis of water, accounts for the properties of photovoltaic batteries. Applied to copper electrodes, it gives a quantitative verification. MLLE. Y. CAUCHOIS and HORIA HULUBEI : The characteristic X emission of the elements in the gaseous state. The *K* spectrum of krypton. P. ROUARD : The variations of phase by reflection on very thin metallic layers. P. LAINÉ : The thermal variation of the magnetic double refraction of liquid oxygen. Measurements were made at temperatures between 77·9° and 90·1° absolute, for the green mercury line, wave-length 546. The results are discussed from the point of view of Langevin's theory. JEAN REBOUL : The probable emission of a slightly penetrating radiation by certain metals. Colson has attributed the action of certain metals, especially zinc, on a photographic plate, to the emission of vapours by the metal. The author criticises this view and gives experimental evidence in favour of the effect being produced by a radiation. MME. P. CURIE and SALOMON ROSENBLUM : The fine structure of the magnetic spectrum of the α-rays of radioactinium and its derivatives. W. SWIETOSLAWSKI : An interpretation of the data of Aston. ALBERT PORTEVIN and MAURICE BONNOT : Contribution to the study of the constitution of the ternary magnesium-copper-silicon alloys. TAUZIN : The inflammation temperatures of detonating gas at atmospheric pressure. M. CHATELET : The two associations iodine-pyridine-water. R. SUTRA : The action of acetic anhydride on starch in the presence of sulphuric acid or phosphoric acid. F. DAMANSKI : Contribution to the study of the constitution of starch. A new method of acetylation. The product of the reaction of acetyl chloride upon pyridine at −20° C. is allowed to react upon dried starch. The results with various preparations of starch are given graphically. R. TRUCHET : The oxidation of bi-substituted acetylene hydrocarbons by selenium dioxide, SeO_2. The hydrocarbons studied were of the general formula $C_6H_5.C{\equiv}C.R$. Only the group R is affected by the selenium dioxide, and the results depend on the nature of this group. G. VAVON and MLLE. BOLESLAWA JAKUBOWICZ : Asymmetrical syntheses by hydrogenation with platinum black. J. HOCH : New methods of preparation of the diarylacetic acids and their derivatives. MLLE. S. GRATEAU : An example of steric hindrance in the acidocyclopentanone series. RENÉ JACQUEMAIN : The preparation of mesityl oxide by the method of Bodroux and Taboury. ANDRÉ LENOBLE : The schisto-quartz-limestone series in the north-east of Madagascar. P. SELTZER : The vertical distribution of the air temperature in the first two metres above the ground. BOGDAN VARITCHAK : Nuclear evolution in *Pericystis alvei*. R. QUETEL : The mechanism of forcing plants by ether vapour. Does this cause a dehydration of the tissues ? The author's experiments do not support the view that forcing plants with ether vapour causes a partial drying of the plant tissues.

COPENHAGEN

Royal Danish Academy of Science and Letters, Nov. 18. HARALD BOHR : Almost periodic functions. H. BOHR and B. JESSEN : Contributions to the theory of almost periodic functions.

Dec. 2. NIELS BOHR : The limited measurability of electromagnetic fields of force. An investigation in collaboration with L. Rosenfeld proves the existence of a limitation of the measurability of electromagnetic field components, conforming with the tentative rational formulation of quantum electrodynamics, and analogous to the characteristic complementary limitation of the measurability of mechanical quantities, which secures the consistency of quantum mechanics.

April 21. TH. MORTENSEN and L. KOLDERUP ROSENVINGE : A new alga, *Coccomyxa astericola*, parasitic on a starfish. This alga is parasitic on *Hipparteria phrygiana*, dredged near Bergen on the west coast of Norway. It resembles the alga *Coccomyxa Ophiuræ* parasitic on *Ophiura texturata*, which was discovered in the Limfjord and described by the authors in 1910.

May 5. J. N. BRØNSTED : (1) The definition of the Gibbs potential. A reply to recent criticism. (2) Use of osmotic pressure in chemical thermodynamics. Several of the physical chemical equations which are based upon the analogy between gas pressure and osmotic pressure contain an essential inaccuracy due to the insufficiency of this analogy. This is shown in detail for the case of the dependence of solubility upon temperature. C. WESENBERG-LUND : Contributions to the development of the Trematoda Digenea (2). The cercaria stage. 58 species of cercariæ are described and drawn with camera. The paper contains contributions to the biology of the cercariæ. Several groups may be regarded as true plankton organisms. The relation to the molluscs and the manner of encystment are discussed. Special stress is laid upon the study of the Danish cercariæ parasitic on blood.

ROME

Royal National Academy of the Lincei, Feb. 5. E. ALMANSI : Deformations of elastic strips (4). L. CAMBI : The constitution of 'blue' acid and the reactions of the lead chamber. Recent results of investigations on the chemistry of the lead chamber process

for producing sulphuric acid reveal the possibility of the formation of additive compounds of nitric oxide and acids in general: NO + HX→[NHO]X. Moreover, Berl's observation that 'blue' acid decomposes to give nitrosylsulphuric and sulphurous acids furnishes indirect confirmation of the intervention of nitroxyl, HNO, in the reactions of the lead chamber. The complex formula, $HSNO_5(NO)_n$, suggested by Manchot for 'blue' acid, is improbable, as this acid is produced directly from nitric oxide and concentrated sulphuric acid. B. SEGRE: Geometry on an algebraic variety. A résumé is given of results, mainly numerative in character, relating to the algebraic V_3. O. OBRECHKOFF: The means of Cesàro and Riesz of Fourier's trigonometric series. E. CIANI: Biquintuples of straight lines. G. D. MATTIOLI: Theory of turbulence. A dynamic theory of turbulent fluid motions in cylindrical tubes of circular cross-section is advanced. The assumption is made that such type of efflux has been already established, so that no attempt is made to explain the initiation of the turbulence, that is, the sudden change to the turbulent motion. T. LEVI-CIVITA: The number of impacts in the problem of n bodies the mutual attraction of which varies inversely as any power of the distance. A. DE MIRA FERNANDES: The unitary theory of physical space. P. PRINCIPI: The age of the 'scaglia cinerea' of the central Apennines. This complex material is referred to the Eocene, as it contains nummulites of the Suessonian, Lutecian and Priabonian. A. CAVINATO: Contribution to the petrography of Sardinia. So-called quartzites of Sarrabus, an interesting phenomenon of metamorphism induced by granitic magma in the chalks of the upper Ordovician. M. FEDELE: The complex of functions which intervene in the ingestive mechanism of the Salpidæ. G. BRUNELLI: Investigations on coastal marshes. A. BUSACCA: Experimental reproduction of an anatomo-pathological condition similar to that of human trachoma.

Forthcoming Events

SOCIETY OF CHEMICAL INDUSTRY, July 10–14.—Annual Meeting at Newcastle-on-Tyne. Dr. R. H. Pickard: "The Industrial Use of Textiles" (Presidential Address).

INSTITUTION OF MINING ENGINEERS, July 12–14.—Summer Meeting at Edinburgh. J. Brass: President.

Official Publications Received

GREAT BRITAIN AND IRELAND

Handbook and Guide to the Gallery of Economic Botany in the Public Museums, Liverpool. Pp. 75+11 plates. (Liverpool.) 6*d*.

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 2, No. 11: On the Pituitary in Lepidosiren and its Development. By T. Kerr. Pp. 147–150. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 9*d*.

Harper Adams Agricultural College, Newport, Shropshire. Advisory Report No. 8: Report of the Advisory Departments, 1932–1933. Pp. 28. (Newport.)

Proceedings of the Society for Psychical Research. Part 131, Vol. 41, June. Pp. 255–330+6 plates (London: Society for Psychical Research.) 6*s*.

Population: Journal of the International Union for the Scientific Investigation of Population Problems. Vol. 1, No. 1, June. Pp. 78. (London: George Allen and Unwin, Ltd.) 2*s*. 6*d*. net.

The Scientific Journal of the Royal College of Science. Vol. 3: containing Papers read during the Session 1932–1933 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 120. (London: Edward Arnold and Co.) 7*s*. 6*d*.

National Laboratory of Psychical Research. Bulletin 5: Rudi Schneider; the Vienna Experiments of Professors Meyer and Przibram. Pp. 31. (London: National Laboratory of Psychical Research.) 2*s*. net.

OTHER COUNTRIES

U.S. Department of Agriculture. Circular No. 266: The Citrus Insects of Tropical Asia. By Curtis P. Clausen. Pp. 36. (Washington, D.C.: Government Printing Office.) 5 cents.

Transactions and Proceedings of the New Zealand Institute. Vol. 63, Part 2, February. Pp. iv+81–236+plates 19–28. (Dunedin.)

International Distribution Commission. The United States Census of Distribution 1930: a Report prepared for the Commission by the International Management Institute. Pp. 72. (Geneva: International Management Institute.) 2 Swiss francs.

U.S. Department of the Interior: Geological Survey. Bulletin 830–B: Geology of the Robertson, Humdinger and Robert E. Gold Mines, Southwestern Oregon, by Philip J. Shenon; Notes on the Chieftain and Continental Mines, Douglas County, Oregon, by Francis G. Wells. (Contributions to Economic Geology, 1931–32, Part 1.) Pp. iv+33–64. 15 cents. Bulletin 839: Geology of the Boston Area, Massachusetts. By Laurence LaForge. Pp. v+105+15 plates. 40 cents. Bulletin 840: Geology and Mineral Resources of the Middletown Quadrangle, Pennsylvania. By George W. Stose and Anna I. Jonas. Pp. v+86+15 plates. 40 cents. Bulletin 841: Geology and Oil Possibilities of the Moab District, Grand and San Juan Counties, Utah. By A. A. Baker. Pp. v+95+11 plates. 50 cents. Bulletin 844–A: Mineral Industry of Alaska in 1931, and Administrative Report. By Philip S. Smith. (Mineral Resources of Alaska, 1931.) Pp. iii+117. 10 cents. Bulletin 844–B: Mineral Investigations in the Alaska Railroad Belt, 1931. (Mineral Resources of Alaska, 1931.) Pp. ii+119+1 plate. 5 cents. Professional Paper 175–C: Replacement Origin of the Albite Granite near Sparta, Oregon. By James Gilluly. Pp. ii+65–81+plates 19–23. 5 cents. (Washington, D.C.: Government Printing Office.)

Statens Meteorologisk Hydrografiska Anstalt. Årsbok 12, 1930. iii. Vattenstånden vid Rikets kuster. Pp. 21. 2.00 kr. vii. Meteorologiska iakttagelser i Riksgränsen. Pp. iv+58. 4.00 kr. Årsbok 13, 1931. v. Hydrografiska mätningar i Sverige. Pp. 12. 2.00 kr. vi. Aerologiska iakttagelser i Sverige. Pp. 15. 3.00 kr. Årsbok 14, 1932. 1. Månadsöversikt över väderlek och vattentillgång jämte anstaltens årsberättelse. Pp. 89. 2.50 kr. (Stockholm.)

Papers and Proceedings of the Royal Society of Tasmania for the Year 1932. Pp. v+77+23 plates. (Hobart.) 5*s*.

American University of Beirut. Bulletin of Information, 1932–1933; with Announcements for 1933–1934. Pp. 45. (Beirut.)

Punjab Irrigation Research Institute. Research Publication, Vol. 5, No. 1: An Optical Lever Siltometer. By Dr. V. I. Vaidhianathan. Pp. 17+12 plates. (Lahore: Government Printing Office.) 1 rupee; 1*s*. 6*d*.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 426–430: Synthèse de la northupite, de la tychite et de nouveaux minéraux artificiels du même groupe, par Tokunosuké Watanabé; Les structures cristallines de la northupite $2MgCO^3 2Na^2CO^3 2NaCl$ et de la tychite $2MgCO^3 2Na^2CO^3 Na^2SO^4$, par Tokunosuké Watanabé; Über die Polymerisierung der Methylester höherer ungesättigter Fettsäuren, 12: Über die Struktur des intramolekularen Reaktionsproduktes vom Methylester der Clupanodonsäure, von Kiichiro Kino; Application of the Raman Effect to the Investigation of the Molecular Constitution in Organic Chemistry, Part 1: On the Constitution of Aliphatic Diketones and Resorcine, by Taro Hayashi; Zur Reflexion der Kathoden-Strahlen an der Einkristalloberfläche, von Seishi Kikuchi und Shigeo Nakagawa. Pp. 35–91+plates 5–10. (Tokyo: Iwanami Shoten.) 60 sen.

Studies from the Connaught Laboratories, University of Toronto. Vol. 5, 1931–1932. 58 papers. (Toronto: University of Toronto Press.)

Report of the National Research Council for the Year July 1, 1931—June 30, 1932. Pp. iv+99. (Washington, D.C.: Government Printing Office.)

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1932, by the Department of Agriculture. Pp. 39. (Salisbury.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 5, Mai. Pp. 187–232. (Prague: Regia Societas Scientiarum Bohemica.)

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