



SATURDAY, JUNE 29, 1935

No. 3426

Vol. 135

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Editorial and Publishing Offices :

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Social Research and Industrial Reorganisation

ASSOCIATED with the general satisfaction at the improvement in trade which finds expression to-day, there is a desire to understand, and use to advantage, the factors responsible for the better conditions which prevail. It is clear that, on the whole, 1934 recorded a distinct advance over 1933. In most countries unemployment continued to diminish, production to increase and exchanges remained more stable. In some countries the belief became current that the depression was already passing into history. While, however, it may be fairly said that the world's economic life has been running in smoother and deeper channels, it is still far from having returned to the broad, even flow of real prosperity. The imminent dangers of renewed international competition in armaments alone should make even the most thoughtless pause before indulging in extravagant prophecy about the return of an age of prosperity; but there are many other facts which should discourage easy optimism. Not the least of our present perils is that the improvement in trade which has undoubtedly been experienced in Great Britain and elsewhere may be interpreted by partisans as the fruit of policies and methods which impartial investigation might reveal as really hindering recovery.

The annual reports of the director of the International Labour Office provide an expert examination and analysis of the social and economic conditions of the world which assists even the layman to probe the partisan claims with which he is often assailed. Mr. H. B. Butler's latest report* is no exception to the rule. His analysis shows clearly that hopes of a general recovery have not materialised. Recovery is still superficial rather than fundamental. There is still widespread distress and frustration of hope. There is no sign of a general swing-back of the pendulum to prosperity without any basic disturbance of the economic system having taken place and without any serious political consequences having ensued.

There is much indeed in Mr. Butler's survey that is not only highly interesting to scientific workers, but also significantly in line with the conclusions of many among them who have endeavoured to arrive at an impartial opinion on the present situation and the means of recovery. Controversy still unfortunately rages round many

* Report of the Director, International Labour Office, Geneva, 1935

questions such as that of public works as a remedy for unemployment, nurtured more by the desire to prove or disprove the value of some economic doctrine or political attitude than by any judgment of the real facts.

If, however, there is one thing which is more and more clearly evident, it is that policies of temporising or dalliance with prejudice rather than facts are not only ineffective but also liable to be disastrous. Everywhere fatalistic belief is giving way to the demand for systematic collective action; and Mr. Butler in his survey notes that, in dealing with the problems presented by the depression, those Governments which have adopted unorthodox measures have, on the whole, succeeded better than those which have relied on the traditional processes. Deliberate interference by the State in economic affairs has continued to increase rather than to diminish. Its success appears to be justifying and strengthening the popular belief that by bold, well-conceived steps planned on a sufficiently comprehensive scale, Governments can influence the course of recovery to a very considerable extent.

This growing reluctance to accept the thesis that human agencies are impotent to control the fluctuations of economic fortune is one of the most significant and hopeful signs of the present time. Its very existence is a psychological element in the general situation which cannot be ignored. In addition, it represents not merely confidence in the ability of man to regain control over events, but also a willingness to accept change, to try new methods. It is a hopeful sign in itself which permits the co-operation of the scientific worker and the application of the scientific method to these difficult problems. There could be no greater tragedy than for the slight recovery which has been experienced in the last year to blind us to the necessity for fundamental investigations and perhaps changes of policy and methods, if the full recovery and the alleviation of the hard core of unemployment and general distress, which are undoubtedly within our powers, are to be secured.

Against this very real danger, one of the surest safeguards is the extent to which recent and more fundamental attempts to modify and adapt the old economic structure to meet the new conditions have been inspired in the main by social considerations. It is not merely that Governments are expected to devote the same energy, ingenuity and attention to the provision of the elementary needs of feeding, clothing and shelter on a civilised

scale as to the promotion of air communications, wireless services and elaborate systems of national defence. Questions of organisation of industry, hours of work and the like are judged more and more from a social point of view than from that of financial or technical efficiency alone.

To these social implications, Mr. Butler, in the report to which we have referred, directs special attention. In commenting on relief of unemployment, he points out that the failure of relief, while warding off actual starvation, to prevent progressive under-nourishment and demoralisation of individuals and families where unemployment is of long duration, is leading to an increasing demand for adoption by the State of energetic measures to create work, whether direct or indirect. His reference to the devastating effect of juvenile unemployment is pertinent in relation to the Jubilee Trust Fund recently inaugurated in Great Britain. For juvenile unemployment, relief affords no solution. "No social problem is of more vital importance and it may safely be said that money saved by ignoring the dangers of intellectual, physical and moral deterioration to which the young unemployed are exposed represents the worst and most short-minded form of national economy".

This growing insistence on the importance of the social factor coincides with a wider recognition of its importance on the part of scientific workers themselves. Julian Huxley has suggested that the main trend of post-War thought, where not merely pessimistic or destructive, is in the direction of science tempered by humanism; and the refusal of public opinion to consider the improvement of production, the growth of retail sales or the appreciation of securities as in themselves satisfactory unless accompanied by a corresponding reduction of unemployment, is paralleled by growing attention to the social factors on the part of scientific workers, whether as affecting the direction or conditions of their own work or as a field for further investigation.

It is in fact at last being widely realised that an elaborate mechanical organisation is often a temporary and expensive substitute for an effective social organisation or a sound biological adaptation. The error of confusing efficiency with adaptation to large-scale production is being more and more apparent, and in many fields, organisation and processes are being judged less by their purely mechanical or technical efficiency than by their social consequences in the widest sense. What the product contributes to the labourer becomes as

important as what the worker contributes to the product.

From this point of view the ideal of fitness for a purpose implicit in technology acquires a new significance. The rationalisation of industry is no longer considered merely from a technical or economic point of view. The entire social situation must be taken into account. A process which promises higher technical efficiency may indeed be rejected, for example, either because of the untoward disturbances it produces in the State as a whole or because of the risks it involves to the health of the worker. As Mumford suggests in "Technics and Civilisation", "a rational society might alter the process of motor car assemblage at some loss of speed and cheapness to arrive at a more interesting routine for the worker. Similarly it would either go to the expense of equipping dry-process cement-making plants with dust removers—or replace the product itself with a less noxious substitute. When neither alternative was practicable it would drastically reduce the demand itself to the lowest possible level".

In this attitude there is essentially no slowing up of progress. On the contrary, while the direction of research may be changed, its scope is enlarged.

The realisation that industry offers opportunities for creative experience which is social in its processes as well as in its objects gives a new impetus to research over a wide front. Such bodies as the National Institute of Industrial Psychology are indeed only faintly foreshadowing the services which they can render, when industry and society are widely permeated with an ideal of efficiency or rationalisation which takes full account of the worker and the social consequences, as well as of the process, the product and the economic return. The following out of the principle of economy in its highest and truest sense means that at least as much attention will be paid to the choice of the correct means of avoiding waste of human effort and welfare as to the choice of the appropriate apparatus or raw materials. The stress laid upon the problem of unemployment in the midst of the Jubilee rejoicings emboldens the hope that, so far from the partial recovery already experienced leading us astray, there is a growing determination to seek new ways and means, if those of the past prove inadequate to solve this problem and secure the wider distribution of the vast resources at man's disposal, could he but make mechanisation his servant and not his master.

Reviews

The Arachnida

The Arachnida. By Theodore H. Savory. Pp. xi+218+8 plates. (London: Edward Arnold and Co., 1935.) 25s. net.

THE Arachnida have been unduly neglected by zoologists, having been overshadowed as objects of study by the beauty and infinite variety of the insects. The study of the class has been difficult, owing to the scattered literature and the scarcity of several of the forms. Of the ten existing orders, only four are represented in Great Britain, and several of the smaller orders do not reach the confines of Europe. Mr. Savory has now given us a generalised account of the class as a whole, for which all zoologists and naturalists will be grateful.

The Arachnida, more than the insects, have attracted the attention of philosophical morphologists, since the days when Strauss-Dürkheim, so long ago as 1829, first pointed out that *Limulus* is an arachnid, and the close resemblance between that genus and the Eurypterida has long been recognised. It is remarkable that of these two primitive groups, *Limulus* has survived, being to-day not only by far the largest arachnid, but

also the only marine one, while the Eurypterida, making their first appearance in the Cambrian, attained their zenith in the Silurian, producing such extreme forms as *Stylonurus* of the Old Red Sandstone, which reached the enormous size of ten feet, with very long legs. These gerontic characters foretold an early extinction, for the order made its last appearance in the early Carboniferous.

In discussing the evolution of the class, the author quotes the theory associated with the names of Ray Lankester and Pocock, according to which *Limulus* and the scorpions were both derived, each through an intermediate link, from the Eurypterida, which in turn, through *Limulava*, came from the Trilobites. In any event, all will agree that the Eurypterida, *Limulus* and the scorpions undoubtedly have a common origin. Zittel derives all three from a hypothetical early Cambrian predecessor, reserving the Trilobites as ancestors of the Crustacea. But, as the author points out, if by this hypothesis he would exclude the Trilobites from being at the same time ancestor of the Arachnida, he is virtually denying evolution.

The critical step in the evolution of the class

was in the Silurian, when they changed from an aquatic to a terrestrial habitat, *Limulus* alone retaining a marine life, with gill-books.

Leukart, Hansen and Sørensen, from a study of the breathing apparatus, draw conclusions different from the English morphologists. They regard the Palpigradi and Solifugæ as being the nearest survivors to the primitive type, which, they maintain, was terrestrial, the crustacean characters of *Limulus* being due to convergence.

Mr. Savory prefers to suspend judgment. He points out that the Arachnid-Crustacean-Myriapod group of the phylum Arthropoda are all built upon a 21-somite plan, and evolved from a vermiform ancestor, which must be sought in the pre-Cambrian in the *Oncophora*, as Versluys and Demoll have sought to establish.

As to the genetic relationship within the class, the one point on which there is general agreement is that the ten existing and seven extinct orders cannot be arranged in an ascending series. It is also accepted that the scorpions are the most primitive terrestrial forms, with the Pedipalpi and Solifugæ very close. The spiders are the most highly specialised, and the Acari are certainly degenerate, with the Opiliones intermediate. The system adopted by the author is that drawn by Pocock, with slight modifications, as the rejection of the Trilobites, which are now generally regarded as Crustacea, the inclusion of the fossil orders, and the rejection of the Pantopoda, Pentastomida and Tardigrada. From the discontinuous relationship between the orders, Mr. Savory draws the conclusion that "the hypothesis of an evolution taking place by slow successive degrees is not in accordance with the facts".

One feature of the Arachnida which makes them so attractive is their conservatism, the survival of such primitive and ancient forms as *Limulus* and the scorpions, which Ray Lankester has described as "the oldest animal form of high elaboration which has persisted to the present day". Scorpions first appear in the Silurian, as pioneers of the air-breathers, and were as highly developed by the Carboniferous as they are today. Four other orders share the pride of almost unaltered descent from Palæozoic days, the Opiliones, our familiar harvestmen, the Solifugæ or wind scorpions, and the Pedipalpi.

The most surprising group in the class is the Ricinulei or Podogona. These extraordinary little creatures, which have never evolved eyes, appear to have scarcely any sense organs and carry their genitalia in the tarsi, were first discovered in the Carboniferous of Illinois in 1837. In the following year Guérin described a living specimen from West Africa. Now there are six fossil and thirteen living species known, but the astonishing thing

about them is that to-day, almost a century after their discovery as living creatures, only thirty-two specimens are known to exist. As the author says, each specimen seen by man is something of a historical event.

Mr. Savory's concern is not confined to the taxonomic and evolutionary aspect of the study. In the text he brings out many points of the highest interest, with a literary skill unusual in purely scientific works. He points out that the time has come for arachnology to possess the same unity and status enjoyed by entomology, and that the day has come for a science of comparative arachnology. He gives a series of essays, interlarded as 'Excursus', which well repay reading, and a clear summary of the structure, classification and evolution of the class, the habits of the creatures and their behaviour, in which he explains, for the non-specialist, modern views on instinct, reflexes and tropisms, with an indication of the work that has been done on their courtship, mating, dispersal, distribution and manner of life. To make the work complete, he includes an outline of those groups which have been doubtfully associated with the Arachnida, such as the Tardigrada, Linguatulidæ and Pycnogonidia, with essays on laboratory work, the economic aspect, and an outline bibliography. M. B.

Theoretical Materials and Experimental Structures

- (1) *Theory of Elasticity*. By Prof. S. Timoshenko. (Engineering Societies Monographs.) Pp. xvi + 416. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30s. net.
- (2) Department of Scientific and Industrial Research. *Second Report of the Steel Structures Research Committee*. Pp. xviii + 369 + 25 plates. (London: H.M. Stationery Office, 1934.) 7s. 6d. net.

FOUR of the leading engineering institutions of America have engaged in a fresh enterprise in technical literature. Selected manuscripts of value to engineers and industry, but of probably limited appeal because of their special nature or treatment, are to be produced in a series entitled "Engineering Societies Monographs". Prof. Timoshenko's volume is the first to be issued and gives a fine impression of the high standard intended.

The author's previous volumes on "Strength of Materials" (reviewed in NATURE, 128, 617, Oct. 10, 1931) dealt with engineering materials in a very thorough fashion, but in the order of development more usual in technical treatises on the subject. The present work on theory is guided largely by the mathematical bases, and in classification and details departs from this common order.

The mathematical method and the engineering method in theoretical development are in direct contrast. The former seeks primarily the most general treatment and formulation, and then particularises to elucidate problems of a class. The engineering application is an exercise. The latter method uses elementary theory so far as it will go, without greatly emphasising its shortcomings until it ceases to work satisfactorily. The practical problem is the main aim; and the elementary methods are quite acceptable so long as they give rational guidance in design. They do so in many important lines of study, such as bending theory; but it is the failure of these methods in the more difficult modern problems of construction that renders such a work as the present volume important and necessary to engineers.

It has been estimated that 80–90 per cent of the failures occurring in modern engineering construction are due to fatigue. This evil displays itself as a progressive cracking developing from zones of high stress concentration due to form variations or discontinuities, holes, corners and re-entrant angles. The treatment of stress concentration is quite beyond the elementary theory, so prominent in engineering curricula; but the results in practice emphasise the failure of the theory—and the curricula—by the failure of the parts. The experience only slowly affects technical literature, but has certainly dated the older textbooks on materials. Prof. Timoshenko has taken a very active part in the investigation of the subject, and he is also to be congratulated on his activities in rewriting its literature.

While it is necessary to decrie the powers of elementary methods of stress analysis, it must not be supposed that more powerful mathematical methods can always provide full solutions. Investigation on materials and structural forms to-day is a remarkable mixture of analysis by formal elastic theory and by energy methods; by direct experiment; by indirect experiment such as the photo-elastic method; and by the use of analogies such as the soap film, the hydrodynamical and the electrical parallels. Prof. Timoshenko gives all these methods due attention. His book is not a mere array of theoretical developments, but a powerful attack upon, and a careful classification of, all methods aiding the solution of specific engineering applications.

The author's arrangement is of distinct interest. Two-dimensional problems are dealt with by rectangular and polar co-ordinates and by the use of the complex variable. There is a general analysis in three-dimensional work with an extensive consideration of torsion and bending, including a careful discussion of analogous methods. Strain energy methods and theorems are adequately

presented and there are special and characteristic chapters on axially symmetrical stresses and wave propagation. Apart from the last, vibration problems are not considered; and instability problems are not dealt with in this text. The wealth of reference, by footnote and otherwise, greatly enhances the value of the book, while it displays the author's scholarship and not infrequently discloses his personal share in the development of the subject.

(2) In Timoshenko's work the methods of theoretical investigation in elasticity are presented in classified array with the problems which they solve, help to solve or hope to solve. But when these are gathered together, they cannot be found to include with any confidence in any category the apparently simple column and beam system that, with its connexions and supports, comprises the standard building frame. The method of inquiry into this important structural form initiated by the British Steelwork Association and directed by the Steel Structures Research Committee affords a definite contrast with purely theoretical discussion. It calls for a close and patient establishment and examination of experimental, statistical and theoretical data, with a view to the formulation of comparatively simple design codes. These must avoid highly elaborate calculations and yet allow of reasonably correct assessment of intricate factors such as are created by the interactions of columns and beams through their connexions.

In its first report in 1932, the Committee disclosed its plans for systematic research, and recommended a code of practice incorporating up-to-date ideas and effecting economies in design. The code was a tentative effort at order and scarcely pretended to elucidate fully the problems concerned with the contractions of the structural elements. In this second report now issued, the Committee shows itself mainly engaged on these difficulties, and presents a remarkable collection of data and ideas relevant thereto.

The usual assumption of completely rigid joints in built structures is only a simplification in calculation. It is recognised to be untrue. Some slip must occur at the connexions. The amount of this has been variously assumed for different purposes, but the Committee rightly deals with this question as one of the vital matters at issue. The procedure followed has included investigation of the actual behaviour of connexions in full-scale experimental frames; the measurement of stresses in actual building frames before and after encasement in concrete; and an elaborate investigation of various forms of connexions and bolted joints.

The experimental building frame was described in the first report. Dr. Baker, the technical officer

to the Committee, now presents an interesting report on the results obtained for single-bay and two-bay arrangements, and discloses the surprising fact that quite slight differences of some kind in the connexions result in considerable variations in the stresses. Even with the use of the experimental refinement of a 'torque control' spanner for the joint bolts, discrepancies of a fair amount still existed. Dr. Faber deals with the tests and stresses in the steel frame structure at the Museum of Practical Geology, South Kensington; while Prof. Batho and others discuss very fully experimental and analytical work on joints, bolts and connexions. This last includes interesting and unusual work on bolt stresses and torque control in tightening. In fact the 'torque control' spanner is a surprising but noticeable and recurring feature of this report, and we may be allowed to wonder whether it will ultimately appear in building codes.

The report also contains an excellent discussion on analytical methods by Dr. Baker, including a treatment of mechanical analysis by models. There is a concluding section of distinct importance on the strength of welded joints carried out for the Committee at the National Physical Laboratory and containing valuable results on the hitherto somewhat neglected aspect of fatigue strength. Altogether this report contains a vast amount of vital information. It requires careful study; but the study will be well repaid.

Electrokinetic Phenomena

Electrokinetic Phenomena and their Application to Biology and Medicine. By Dr. Harold A. Abramson. (American Chemical Society, Monograph Series, No. 66.) Pp. 331. (New York: The Chemical Catalog Co., Inc., 1934.) 7.50 dollars.

DR. ABRAMSON'S monograph is planned partly on historical principles. In his first chapter he records the discovery of the phenomena classified by colloid chemists as capillary-electrical or electrokinetic, namely, the flow of fluid past a wall and the movement of a small particle caused by an electric current, and the converse phenomena, referred to as the flow potential, set up by the movement of liquids through porous diaphragms. In the second chapter, he describes the correlation between these phenomena and potentials at surfaces, worked out by Helmholtz and by Smoluchowski. More recent work, based on the conception that an ion atmosphere is present at the surface, due to Gouy and to Debye and Hückel, is recorded in the fourth chapter.

Experimental methods, including the apparatus used by Abramson in his studies of particles coated with proteins, are described in the second chapter,

and the remaining chapters describe experiments on proteins, inert surfaces, inorganic and organic surfaces, gases, blood cells, bacteria and related systems. From some points of view, an arrangement in which the simpler systems are dealt with first might be preferable, but there are certain advantages in considering the proteins first. In the words of the author, "Although the proteins are complicated from the point of view of their chemical structure, from another aspect they are less complicated than any other surface to be discussed here, for the reason that the average electric charge Q per dissolved molecule can be determined by a thermodynamic method. This charge so determined, can serve as a reference with which the validity of the theories of electrokinesis . . . can be tested".

In the account of the thermodynamic method, evidence is recorded in favour of the view that protein chlorides are fully ionised in dilute solutions, and it is concluded that the charge can be calculated from the acid or base bound, as measured by the hydrogen electrode. It is shown that such titration curves can be superposed on curves showing the relationship between mobility and pH value, recorded by Tiselius and by other investigators. These observations support the thesis that, in some respects at least, the protein surfaces are particularly favourable for experimental investigations. It may be noted that the observations of Freundlich on inorganic surfaces showed no correlation between electrokinetic and thermodynamic potentials.

In a field complicated by many unknown factors, the discovery of simple relationships is of great value, but in a review of the work it is perhaps advisable to point out that there are certain qualifications of the conclusions drawn by Abramson, which have not been stated in his book. In the first place, the amount of acid or base combined with a protein at a given pH is not independent of the amount of neutral salt present, as shown by Sørensen, Linderstrøm-Lang and Lund.

In the second place, it may be noted that since the publication of this book, additional evidence concerning the validity of the author's method has been obtained by comparing measurements of titration curves and valences calculated from membrane potentials, and it would appear that the results calculated from titration curves may be subject to appreciable corrections.

Although differences of opinion may be held on certain points, there is no doubt that Dr. Abramson's book should advance the study of electrokinetic phenomena, as he has brought together recent work on the physical theory of the double layer, and experimental data obtained in the fields of chemistry, biology and medicine.

Short Notices

Structural Design in Steel. By Prof. Thomas Clark Shedd. Pp. ix+560. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 25s. net.

THE professor of structural engineering in the University of Illinois, recognising the impossibility of adequately covering the whole field of structural design in a single volume, has confined his attention to the fundamental principles of steel structures, and has produced an eminently practical manual, interspersed with numerous worked-out examples of calculations, which will be of considerable assistance to the draughtsman, the designing engineer and the student.

Commencing with an introductory chapter of a general character, the book goes on to discuss structural types and framework, the design of beams and girders, tension and compression members, and connexions. Then follow two chapters dealing with the design of structures as a whole: one on buildings, primarily of the industrial type, and the other on bridges, both roadway and railway. Both chapters include detailed sets of illustrative calculations of a practical character. Since fusion welding is now widely used as a means of jointing, and is not so adequately standardised as the older forms, the author has discussed the subject in a special chapter. Three appendixes, covering general specifications in design, based on standard American practice, form a suitable conclusion to the volume, which is clearly and excellently produced, particularly as regards the numerous diagrams and sheet calculations. The illustrations include a number of photographic views of structures in the United States. B. C.

Food and Health. By Prof. Henry C. Sherman. Pp. x+296. (New York: The Macmillan Co., 1934.) 10s. 6d. net.

PROF. H. C. SHERMAN, the author of several scientific books on food and nutrition, has now written a short popular account. A clear description of the caloric requirements of adults and children is summarised in a useful table. Regarding the daily amount of protein, about which there has been so much controversy, Sherman concludes, from direct experimental data, that 44 gm. a day suffices for an adult; for children relatively more, at the figure of 10-15 per cent of the calories. The nutritional responsibilities assigned to the proteins belong rather to the mineral elements and vitamins. The chapters on the vitamins are short. The optimal amounts of each vitamin are four or five times those found as minimal. There are tables, needing corrections, showing the distribution of the vitamins in foods.

A chief feature of the book is the discussion of the supply of mineral salts. Every human being, says Sherman, is born calcium-poor, but iron-rich. The intake of calcium and also of phosphorus must therefore be relatively greater than that of other body-

building foods; the daily amounts are given. Attention to mineral salts and vitamins will more surely lead to buoyant as distinguished from merely passable health. A long list of diets shows how the low protein consumption with high calcium and phosphorus (mainly from milk, of which a quart a day is recommended for children) and ample vitamins can be secured. The book merits every attention.

The Human Gyroscope: a Consideration of the Gyroscopic Rotation of Earth as Mechanism of the Evolution of Terrestrial Living Forms: Explaining the Phenomenon of Sex: its Origin and Development and its Significance in the Evolutionary Process. By Arabella Kenealy. Pp. v+313+16 plates. (London: John Bale, Sons and Danielsson, Ltd., 1934.) 12s. 6d. net.

MISS KENEALY attempts to show that Newton and not Einstein is right; that Einstein's theory contains no creative principle. Her predominant idea is that the development of biologic forms is due to the gyroscopic influence of rotation, acting by way of what she terms the "Great Potter's Wheel of Evolution". She maintains her thesis with a bewildering mass of evidence from many sources, but few of the conclusions she arrives at by skilful argument will bear critical examination. While respecting her convictions and impressed by the advocacy of her case, most scientific readers will remain unconvinced.

Aircraft: Progress and Development. By Capt. P. H. Sumner. Pp. xiv+295. (London: Crosby Lockwood and Son, 1935.) 25s. net.

THIS volume claims to be "a world picture of progress in Aviation". If the author had confined himself to that conception it would have been an interesting book of the historical record type, that should find a place in every library collection directed toward that end. The illustrations and their descriptive matter are exceptionally complete, and must be the result of a very considerable labour in collecting and collating them. The pictures themselves are discreetly chosen and well reproduced. The book fails badly when it attempts to give scientific and technical explanations in too small a compass. Compression of technical statements has led the author into both ambiguities and errors.

Geschichte der physiologischen Chemie. Von Dr. Fritz Lieben. Pp. ix+743. (Leipzig und Wien: Franz Deuticke, 1935.) 20 gold marks.

THIS is a somewhat lengthy historical account of the development of the subject between, or common to, chemistry and physiology, which is now called biochemistry. The story is told at first in connexion with individuals; later it has relation to function and to individual chemical groups. Few will find the leisure to read so long a work, but the author and subject indexes make reference to particular problems easy.

The Geological Survey and Museum

THE new building for the Geological Survey and Museum which has been erected on the west side of Exhibition Road, South Kensington, London, S.W.7, stands in a middle position between the Victoria and Albert Museum, the Science Museum and the British Museum (Natural History). The site which it occupies is part of the ground acquired by the Royal Commissioners of the 1851 Exhibition, and was chosen for this purpose by

stone; but the rest of the building is of brick with stone sills and courses. The shape is a simple rectangle 312 feet long by 100 feet wide and 95 feet high. The Museum occupies the front part of the building while at the rear are the Survey offices, laboratories and library.

Large, metal-framed windows occupy almost the whole of the sides of the building, and in order to secure as much light as possible the amount

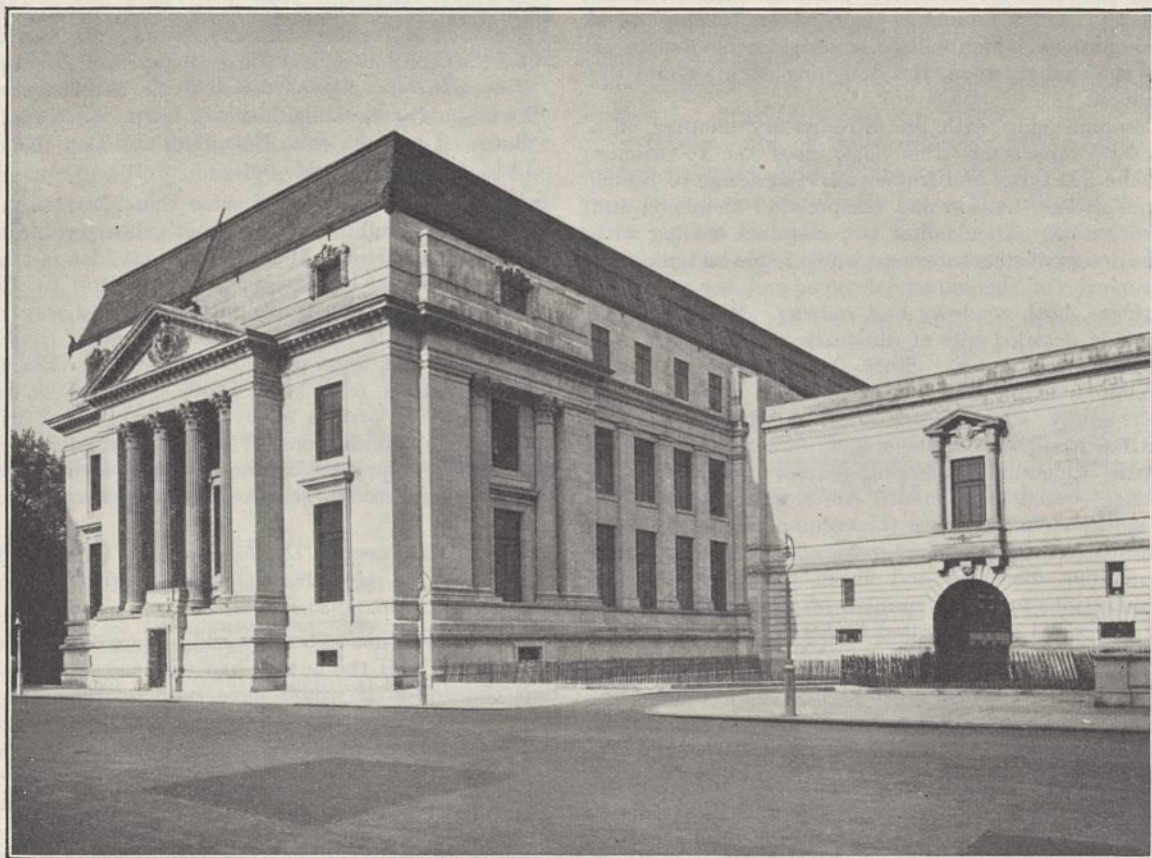


FIG. 1. Geological Survey and Museum, South Kensington.

the Bell Committee (1912). The new Museum (Fig. 1) is linked to the Science Museum by a series of corridors over an arched gateway; at some future time, the Natural History Museum may be extended to the east, and the new buildings will probably join up with the Geological Survey and Museum on its south side.

The building was designed by Mr. John H. Markham, of H.M. Office of Works. Its eastern front, facing Exhibition Road, is of classical design, with a Corinthian colonnade, and has been described by competent judges as one of the most successful recent classical buildings in London. The front archway and part of the north side is of Portland

of dead wall has been severely cut down. The result is that the interior is very well lighted. The general arrangement is that of a central court or well, forty feet wide, lighted from above by a glazed, arched roof, and side galleries, thirty feet wide, lighted by the windows in the walls. The exhibition space comprises a main floor and two galleries, and there are large staircases at each end of the Museum. The galleries are supported on rectangular steel pillars, and the whole building is steel framed, with concrete floors; it is as nearly fireproof as possible. In the Museum there are no partitions, separating the interior into rooms, but the whole structure is open. The



FIG. 2. General view of interior, showing the central court and two exhibition galleries.

entrance hall and eastern staircase are lined with polished marbles, but in the rest of the building there has been no attempt at decoration, and the architect has relied principally on proportion and symmetry to obtain his effects.

The transfer of the collections from the old Museum in Jermyn Street was completed by the end of October 1934, and the old Museum is now being demolished. The Geological Survey and Offices have been occupied, and the library has been open to the public since November. Considerable progress has been made in the work of arranging the exhibits, and when the new Museum is opened on July 3 by H.R.H. The Duke of York, it will be found that all the floors are covered with displays, which are practically entirely new and totally different from those which were shown in the Jermyn Street Museum.

The main floor (Fig. 2) has been devoted to an exhibition of the introductory principles of geology with the object of

interesting the general public who have no special knowledge of the science. A very fine display of gems and semi-precious stones is placed in the centre court. To avoid the disturbing effect of reflections from the roof, the glazed cases have curved tops: they are also provided with artificial illumination. Such minerals as diamond, ruby, sapphire, emerald, topaz, zircon, peridot and lapis lazuli are shown on one side, and on the other onyx, agate, jasper, opal, chalcedony, labradorite and adularia.

The side spaces under the galleries are divided up into bays by means of vertical screens about seven feet high. These screens are covered with photographs showing scenes of geological interest. Each bay illustrates a subject, such as glaciers, earthquakes, volcanoes, marine deposits, river action, rock structure, weathering, the action of plants or the origin of coal. In the table cases a very complete series of specimens, fully labelled, provides examples, mostly of British origin. Each table case also has a medial screen with coloured sketch maps, sections and diagrams. The principle followed has been not to show too many specimens, but to see that all are as typical as possible and to explain their meaning fully and clearly. On this floor also there is a group of dioramas representing picturesque scenes of geological significance, such as the Needles and Alum Bay (Isle of Wight), Edinburgh as seen from Braid Hills, the Avon Gorge (Bristol), Lulworth Cove, Cheddar Cave and Vesuvius (in eruption). It is intended that on this floor the exhibits will interest and attract visitors who have no special knowledge of geology.

In the first gallery, the object aimed at is to



FIG. 3. East end of first gallery, showing division by screens carrying photographs.

show the geology of Great Britain. For this purpose the country has been divided into areas or regions that have a definite geological and also geographical identity. Examples are London and Thames Valley, the Weald of Kent, Devon and Cornwall, South Wales, North Wales, Hampshire Basin, Northern Highlands of Scotland, Central Valley of Scotland. Each region is fully illustrated with maps, photographs, sections, rocks, fossils and minerals. A special descriptive handbook of each province is being written by an expert geologist who knows the district thoroughly.

In the second gallery, the exhibits are intended to explain the origin of the principal metals and the economic application of geology. In the table cases are selected specimens of the ores of iron, lead, zinc, copper, manganese, etc., and also a full exposition of useful non-metallic minerals such as talc, gypsum, china clay, rock salt. In special cases there is a large series of British building stones, and such subjects as roadstones, slates, cements, brick clays and asphalts will also have space assigned to them.

One of the most important features of this Museum is the accommodation provided for research material and for investigators who wish to work on the Survey's collections. In the top of the Museum there is a third gallery (not visible from the main floor) with about 16,000 feet of floor space, excellently lighted. This is to be reserved entirely for cabinets containing those specimens of minerals, rocks and fossils that are of special interest and importance, and likely to be consulted by scientific experts. There is also in the basement of the Museum a large store containing drawers filled with material of less importance which requires to be preserved not for its inherent interest but rather as a record on which statements in the Survey memoirs are founded.

The new Museum and Offices are nearly three times as large as the building formerly occupied. The cost of the building was approximately £220,000. The old Museum in Jermyn Street has been let on a building lease by the Commissioners of Crown Lands at a yearly rental of £11,000.

Clinical Science within the University

IN the Huxley Lecture delivered at the University of Birmingham on March 14 and published in the *British Medical Journal* of March 30, Sir Thomas Lewis made a strong appeal on behalf of the recognition of clinical science, which may be regarded as an answer to the presidential address of Sir Frederick Gowland Hopkins on "Clinical Medicine and Science", a survey of which appeared in *NATURE* of December 8, 1934 (p. 867). In his address Sir Frederick expressed his conviction that the scope for really controlled experiments applicable to the human body was limited, and he deprecated the growing tendency to distribute the funds provided for medical research in the endowment of the clinic at the expense of biological science, and particularly biophysics and biochemistry.

Sir Thomas Lewis started by quoting with approval the declaration made by Sir James Paget sixty-five years ago, that "clinical science has as good a claim to the name and rights and self-subsistence as any other department of biology"; but he used the term "clinical science" in a wider sense than Paget, who confined it to researches on living man, by defining it as "the branch of knowledge that centres upon diseased human beings, but which also includes relevant parts of the allied sciences". The field of clinical science therefore should include physiology, morbid anatomy and experimental medicine.

Sir Thomas emphasised the point that clinical science is not identical with clinical medicine and clinical surgery, and drew a distinction between the science and art of medicine; but he maintains that a university must possess a strong scientific department inspired by direct clinical interests.

As regards experimental work, Sir Thomas declared that every remedy employed to-day is the result of direct experiment on man, as is best exemplified by vaccination, antiseptic surgery and general anaesthesia. Only safe and beneficial experiments are justifiable, and no experiments should be carried out except with the patient's consent. In Sir Thomas's opinion, too many experiments have been and are still being performed; a reduction in their number, and their conduct on a stricter, safer and more productive basis are desirable.

The first requirement of a university department of clinical science is an out-patient department and an in-patient service sufficient to supply ample material for research and teaching, the size of the departments to be decided partly by local conditions and partly by the activities of the professor and his assistants. While admitting that clinical science is essentially a laboratory science, Sir Thomas does not think that the laboratory should be a place reserved for animals. On the contrary, he maintained that laboratories for the

examination of patients as well as of animals should be close to the clinical services, and even directly attached to the ward or out-patient department.

Although many valuable discoveries may still be anticipated from those actively engaged in the practice of medicine and surgery, Sir Thomas expressed his conviction that in many directions advances may more readily come from men who are able to give their whole time to research, unhampered by routine duties. Appointments for clinical research are therefore required, and no more suitable place for such appointments could be found than within a university, where persons engaged in research would enjoy the stimulus derived from teaching and find a congenial atmosphere.

Sir Thomas then passed on to the subject of the medical education of to-day, in which, as is generally agreed, he holds there are grave defects. The curriculum is overloaded not only by the preliminary sciences, including anatomy, physiology and general pathology, but also on the clinical side.

The plan suggested by Sir Thomas Lewis as a remedy is as follows: There should be a first course consisting of the outlines of human anatomy and physiology, with special stress laid on what is immediately applicable to the study of disease. The second course, which would not be compulsory for all medical students but would be suitable to a science degree or to those who intended to take up physiology, pathology or clinical science as a career, would be one of more advanced physiology. The third or final course would consist partly of

general and practical instruction along existing lines, emphasis being laid on all that is essential to general practice. The teaching should be mainly concerned with common diseases and remedies of proved value and ready application. The outlines of clinical science should be included in this course, which would be taken by all medical students, but higher examinations would be held by the Royal Colleges and possibly by the universities, and there might be room for a university degree in clinical science for those who proposed to adopt an academic career.

As to the final stage of the student's preparation for medical practice, Sir Thomas granted that the best teacher is the man in active practice, who not only understands disease and its treatment in detail but is also able to manage sick people and their friends. These accomplishments, however, do not qualify the teacher for the post of university professor in clinical science, whose duties should rather be to deal with the principles and problems of clinical science, and with the patients only to exemplify specific points. The former would include the causes of disease, the principles of hereditary transmission of human diseases, the reaction of man to his environment, physical injuries and chemical poisons, the meaning and effects of infection, the significance of sexual, racial and other predispositions to disease, and the origin of new growths in man.

In conclusion, Sir Thomas repeated that it is largely within the power of the universities to establish clinical science on the same basis as the allied sciences of physiology and pathology, as distinct from the practical art of medicine.

British Chemical Abstracts

ALMOST exactly eight years ago, the appearance of the first annual index volume, covering the whole of the abstracts in pure and applied chemistry prepared and published under the direction of the Bureau of Chemical Abstracts during 1926, afforded us an opportunity of referring appreciatively to a scheme which has since proved a remarkably successful co-operative enterprise.

The Chemical Society, which since 1871 had undertaken the task of supplying abstracts of papers dealing with pure, physical, inorganic, organic, analytical, mineralogical and biological chemistry, and the Society of Chemical Industry, which had similarly surveyed applied chemistry since 1882, had for many years maintained mutually helpful contact between their respective abstracting

organisations; in 1924, however, these two Societies united in establishing the Bureau of Chemical Abstracts, charging the new body with the task of controlling both the preparation and the publication of abstracts in all branches of pure and applied chemistry, and of securing such unification as might prove practicable. By the end of 1925 their efforts had been so far successful that consent had been secured to a common format for the two sections, known as British Chemical Abstracts *A* and *B*, respectively, a considerable amount of overlapping material which had previously appeared in somewhat different forms in both sections was eliminated, and the publication of an annual index envisaging the whole range of pure and applied chemistry was undertaken. A few, of course, shook their heads disapprovingly

at this breach with tradition, and there was some regret—admittedly largely sentimental—at the disappearance of the familiar octavo format; but experience has amply demonstrated the wisdom of the decisions then taken, and, moreover, both American and French chemical abstract publications have since joined the ranks of the 'double column quartos'.

The organisation set up by the Bureau immediately on its establishment had by that time proved to be operating smoothly and efficiently, and the editor, specialist assistant editors, abstractors and indexer settled down to a task of annually increasing magnitude with the firm intention of making *British Chemical Abstracts* the world's best journal of its kind. While there is no means of taking the exact measure of their success, there can be little doubt that, despite the need to trim canvas on occasion the better to ride out financial storms, the Bureau and its staff have provided the English-speaking world with an abstract journal which for accuracy, conciseness, promptitude, relevance and catholicity can fairly claim a place certainly not less honourable than that of any other such journal in any language.

During the past five years, there has been proceeding, concurrently with, and independently of, the preparation of the annual joint indexes, work which has now borne fruit in the completion of a collective index covering the period 1923–32*. This publication, which so far as the Chemical Society is concerned is a continuation of a series of collective indexes dating from 1841, and so far as the Society of Chemical Industry is concerned includes the abstracts published independently in that journal in 1923, is a quarto production of some 2,100 pages referring to authors and 1,766 pages referring to subjects; it has been estimated that the number of entries must considerably exceed half a million. In order to ensure homogeneity it was found necessary to re-index the abstracts in applied chemistry published before 1926, for in the corresponding annual indexes a somewhat different system had been employed. Moreover, the varying spelling of countless Russian, Indian and Japanese authors' names has been standardised so far as possible, although in some cases the decision has necessarily been purely arbitrary; for although the transliteration of Russian characters is consistent when carried out according to the Bureau's scheme, the frequency with which Russian authors publish in other

languages leads at times to their names being transliterated almost out of recognition. Such complications and obscurities as might arise from changes in nomenclature during the period under review, from inadequate identification of authors by their surnames alone, and from the massive entries attributable to the largest industrial firms, have been foreseen and avoided so far as is possible.

In the 'author index', series papers by the same author or authors are collected under one main title, with the years and pages placed after the sub-titles at the end of the entry. The general arrangement of the entries is described in the explanatory notes. The volume contains a greatly extended list of radicals, whilst a new and welcome feature is the chart indicating the numbering of positions in ring systems.

Could scientific achievement be measured in terms of the weight and volume of an index, there would be ample cause for satisfaction on the part of even the most diligent among the workers in this ten-year period. But the mounting figures which record increases in the number of chemical abstracts published annually still reflect a rapid rate of increase in the volume of new material which finds its way into the periodical and patent literature. Figures, of course, can be made to prove almost anything; but an increase from 25,500 in 1932, the last year of the decade, to 29,400 published in 1934 is perhaps sufficient evidence for the assumption that the production of decennial indexes in future will be an even heavier task. The corresponding annual indexes—that for 1934 has just been issued—occupy 578 and 692 pages, respectively.

Provocative, or perhaps merely vacuous, statements regarding the desirability of calling a halt in the publication of chemical literature are still heard; such retrogression is clearly impossible; but on the other hand the desirability of brevity and precision in scientific publications cannot be too insistently urged. So far as abstracts play a part in maintaining the march of progress, we can profitably repeat what we have said before: that since the rate of advance in any branch of knowledge so largely depends on an adequate acquaintance with the experimental results and theoretical views forming the starting point of any new research, the efficiency of the abstracting and indexing service is a matter which closely concerns every investigator, teacher and student. The success attained by the Bureau of Chemical Abstracts is a demonstration of what can be done when interested parties pool their resources, and it should encourage co-operation over an even wider field.

* Collective Index of British Chemical Abstracts. (A) Pure Chemistry and (B) Applied Chemistry, 1923–1932, including the Abstracts published with the *Journal of the Chemical Society* and the *Journal of the Society of Chemical Industry*, during 1923–1925. Part 1: Index of Authors. A–K. Pp. 1092. L–Z. Pp. 1093–2101. Part 2: Index of Subjects. Pp. 1766. (London: Bureau of Chemical Abstracts, 1935.) £8.

Obituary

SIR ROBERT BLAIR

WE deeply regret to record the death, which occurred on June 10, of Sir Robert Blair, Education Officer of the London County Council from 1902 until 1924. Born at Wigtown in 1859, he became a pupil teacher at the Garlieston Public School and later went to the University of Edinburgh, where he took his degree in 1880. He joined Aske's Hatcham school in 1882 and, while teaching, secured the London B.Sc. degree. There followed appointments as head of the Cheltenham School of Science and Technical Institute, Inspector of Science and Art, and Assistant Secretary for Technical Education (in Ireland). In 1904 he was appointed to the London County Council. Among the honours which came to him, in addition to his knighthood, were the Order of the Crown from the King of the Belgians, the LL.D. from his old University, an honorary fellowship of the Royal Society of Arts, and a fellowship of King's College, London. He was president of the Association of Directors and Secretaries for Education in 1914, and president of the Educational Science Section of the British Association in 1920.

It was in London that Sir Robert Blair performed the great tasks which made him famous as an educational administrator. Under his direction the present education system was shaped. In particular, the new organisation called for by the Education Act of 1918 gave him a great opportunity of demonstrating his powers of organisation.

Sir Robert's special interest in technical education was well known, and it was continued and deepened after his retirement. Appointed as the British Association's representative on the Emmott Committee of Enquiry into the Relationship of Technical Education to Industry, he became a member of the executive committee responsible for preparing the report and, following the death of Lord Emmott, carried out the duties of chairman.

Sir Robert's vision of the future was broad, and it was ever present in his work. "Life," he said, "has been extended. The engineer, the chemist and the medical officer have broadened the basis, protected our food supply, and safeguarded the public health. . . . Science has given us a new era." That was his attitude, and it goes far to explain his success as an administrator.

 PROF. W. E. SOOTHILL

THE death of the Rev. W. E. Soothill, professor of Chinese in the University of Oxford, which took place on May 13 at Oxford at the age of seventy-four years, will be widely regretted.

William Edward Soothill was born at Halifax, and after a short term in a solicitor's office became a missionary. He went out to the Wenchow district of China in 1882, and within a short period had acquired a knowledge of Chinese which won the respect of Chinese savants. He became exceedingly

active in the promotion of teaching and training institutions and of preaching stations. He also translated the New Testament into Wenchowese, and made a translation into English of the Analects of Confucius. The scene of these early labours is commemorated in "A Mission in China". This narrative, however, did not appear until 1907, the year in which the scope of his educational activities was much enlarged by his appointment as president of the Imperial University of Shansi, newly founded by Timothy Richard. His success there encouraged him in the endeavour to promote a university for the whole of China; but his plans, when in course of active preparation by a committee at Hankow of which he was chairman, were interrupted by the revolution and the outbreak of war.

Soothill's services to China in England and France during the War were recognised by the award of two Chinese decorations. In 1920 he was appointed to the chair of Chinese at Oxford. By this time it was recognised that he was the foremost Sinologist of the day. He became a member of the governing body of the School of Oriental Studies in London, and in 1926 was a member of the delegation to China in reference to the settlement of the Boxer indemnities.

Prof. Soothill was the author of a number of scholarly works on China and Chinese, including "The Student's Chinese Dictionary", "The Three Religions of China", "China and the West", "A Short History of China" and "The Lotus of the Wonderful Law". His daughter is the widow of Sir Alexander Hosie, and is also known as a writer of authority on aspects of Chinese life and culture.

 MR. D. N. DUNLOP, O.B.E.

MR. D. N. DUNLOP died on May 30 after a short illness. He was born in Ayrshire, Scotland, in 1868, and served his engineering apprenticeship in Glasgow. After experience with the Westinghouse Company, he became in 1911 the first organising secretary of the British Electrical and Allied Manufacturers' Association (B.E.A.M.A.) and in 1917 his post was renamed Director. He held this position until his death. He took an active part in the foundation of the Electrical Research Association and of the Electrical Development Association.

While Dunlop rendered great and enduring services to the British electrical industry, it is chiefly as the founder of the World Power Conference that he will be remembered in wider circles. Not many years after the War, he conceived the idea that engineers and men of science, whose inventions had been so powerful in destruction, should lend their great talents in the rebuilding of the world. He succeeded in enlisting the support of the Council of the B.E.A.M.A., which ensured the necessary financial backing, and on June 30, 1924, the Prince of Wales opened the first World Power Conference.

Dunlop, from the beginning, had the hope that a permanent organisation would grow out of the first World Power Conference. But it was not his intention himself to make a proposal to this end. In the event, all the countries which participated united to demand that the work begun in 1924 should continue and, as is well known, during the past eleven years the second plenary World Power Conference has been held in Berlin and sectional meetings in Basle, London, Barcelona, Tokyo and the Scandinavian capitals, while the Chemical Engineering Congress of the World Power Conference will take place in London next year.

The World Power Conference has, under Dunlop's guidance, become a highly important international body with forty-nine member-countries and a central office in London. But from the beginning he envisaged something much more than a technical organisation of the producers and consumers of power and fuel.

He saw in it the meeting-place between scientific workers and engineers on one hand, statesmen and economists on the other. He placed an even higher value upon the opportunities for personal encounters which the World Power Conference provided than upon the great technical results already enshrined in more than forty volumes of transactions.

WE regret to announce the following deaths :

Colonel W. C. Blackett, past president of the Institution of Mining Engineers and of the North of England Institute of Mining and Metallurgical Engineers, on June 13, aged seventy-five years.

Mr. W. S. Franks, who, for twenty-five years, was in charge of the Brockhurst Observatory, East Grinstead, known for his work on the colours of stars, on June 19, aged eighty-four years.

News and Views

Award of the Albert Medal to Sir Robert Hadfield, Bt., F.R.S.

THE Albert Medal for 1935 of the Royal Society of Arts has been awarded, with the approval of the president, H.R.H. the Duke of Connaught, to Sir Robert Hadfield "for his Researches in Metallurgy and his Services to the Steel Industry". The Society's Albert Medal, its premier award, is given annually "for distinguished merit in promoting Arts, Manufactures or Commerce". It commemorates the work for the Society of the Prince Consort, who for eighteen years was its president, and to whom the success of the Great Exhibition of 1851, organised by the Society, was largely due. Awards are made irrespective of nationality, and the list of former recipients of the Medal includes the leading men of science, inventors and other benefactors of humanity. Seventy-five awards have now been made, of which nineteen have been to workers outside Great Britain. The first Albert Medal (1864) went to Sir Rowland Hill, for his reform of the postal system of Great Britain. In 1866, Michael Faraday was the medallist, and later recipients have included forty-one ordinary fellows of the Royal Society and nine foreign members. The other metallurgists of the distinguished company which Sir Robert Hadfield now joins are Bessemer, Siemens, John Percy and Sir Isaac Lowthian Bell.

The Abbotsbury Swannery

HOWEVER patriotic and air-minded we may be, however much alive to the urgent necessity governing the general policy of the Air Ministry at this particular moment, the proposal to set up an aerial machine-gun practice ground in the very middle of the "Fleet" alongside Chesil Beach in Dorset, was bound to call forth the protests which it has already done in consequence of the near neighbourhood of the famous Abbotsbury Swannery. Not unnaturally, those informed members of the community who are

well qualified to realise the very regrettable consequences which are bound to result, have attempted to make their influence felt. One of the most important would be the all too frequent disturbance of the swans on their very localised winter feeding ground. Founded in all probability in 1044 by the monks of the Benedictine Abbey of Abbotsbury, Lord Ilchester has stated recently in *The Times* (June 18) that the first references to the swannery which he has been able to discover are to be found in the Court Rolls of the Manor, 16, Richard II (A.D. 1393); and there are many others, including disputes about ownership in the time of Queen Elizabeth. The actual number of swans forming this *perfectly natural colony of wild birds* varies around eight hundred. It is, therefore, not only historically and biologically of very considerable interest, but also in all probability it is the largest swannery in Europe at the present moment. Associated with it there are other birds and plants. It has been stated in defence of the proposed target practice ground that birds soon get used to aeroplanes and noise. That is no doubt true; but is not the point. The vital objection is the ploughing up of their feeding ground by missiles. If the choice of such a locality is really a matter of urgent necessity, it seems altogether deplorable.

Maintenance of Life in Isolated Animal Organs

To study the functions of an organ under well-controlled conditions frequently necessitates its removal from the body in order to avoid influences reaching it from other tissues, which it may not be easy to control. It is difficult, however, to maintain the isolated organ in a condition even approximating the normal. One of the greatest advances was made by Knowlton and Starling in 1912, with the introduction of the 'heart-lung preparation'. This consists of the lungs—artificially ventilated—and heart

of an animal, and pumps oxygenated defibrinated blood round an artificial circuit, which may include one or more different organs: the latter are thus perfused with blood under conditions approximating the normal. The preparation, however, only lasts for a few hours. It is reported in *The Times* of June 22 that Dr. Alexis Carrel and Colonel C. A. Lindbergh, the well-known American airman, have devised, at the Rockefeller Institute for Medical Research, New York, an apparatus by means of which isolated organs can be kept alive, even growing, for prolonged periods.

In this apparatus, the organs are removed aseptically from the dead animal together with surrounding tissues, arteries, veins, nerves and lymph vessels: all are kept constantly protected with gauze pads soaked in Dakin's solution. The perfusion fluid consists of blood serum or of solutions containing protein-split products: a small amount of phenol red is added to act as an indicator of the metabolic activity of the organ or of the occurrence of bacterial infection. The air supply, kept in contact with the perfusion fluid, contains 40 per cent oxygen and 3-4 per cent carbon dioxide. The apparatus is kept in an incubator at body temperature. The organs so far kept alive in this manner have included thyroid gland, ovary, adrenal, spleen, heart and kidney, obtained from adult fowls or cats; an ovary actually grew in size and weight by the addition of new cells and tissues. It is hoped to use the method for the study of the production of hormones by the glands of internal secretion, for the isolation of substances essential to the growth, differentiation and functional activity of these glands and for the discovery of the laws of association of organs. It is also hoped to study diseases in isolated human organs. The success of the method depends principally upon maintaining complete freedom from bacterial infection, and secondly on the use of suitable nutrient fluids, difficulties which Carrel and Lindbergh appear to have overcome.

Antiquities from Tell Duweir, Palestine, 1934-35

THE annual exhibition of antiquities from Tell Duweir (Lachish), Palestine, found by the Wellcome Archaeological Research Expedition to the Near East under the leadership of Mr. J. L. Starkey in the course of the excavations of 1934-35, opened on June 24 at the Wellcome Research Institution, 183-193 Euston Road, London, N.W.1. The objects exhibited again illustrate details of culture in the various periods represented on the site, beginning with the extensive prehistoric settlements of the copper and bronze ages and ending with the later Jewish kingdom, when the city suffered the successive onslaughts of Sennacherib and Nebuchadnezzar. Further light is thrown upon the early cave dwellers, and the possible line of development of the localised art reminiscent of Tell el-Amarna, of which evidence was found last year, is suggested by a bone inlay in the form of a head, which seems to be a copy of an ivory original. Another interesting find is an Iron Age burial, which included among its grave furniture

a short-handled iron fork with three long prongs. It is reasonable to conjecture that this implement served the priest to extract joints from the offerings-bin of the sanctuary discovered last year. Culturally and historically, however, the outstanding finds are a further example of the early script, resembling that from Sinai, which adds three characters to those known from last year's find, and a series of letters on ostraka, dating from shortly before the fall of the city, now to be identified with certainty as Lachish. This discovery, long eagerly awaited, alone makes the excavation notable. An instructive commentary on the work of the expedition is afforded by a cast of the bas-relief of the siege of Lachish, now in the British Museum, which, coloured and skilfully flood-lit, can be seen in full detail for the first time. The exhibition is open daily from 11 a.m. until 5 p.m., and on certain evenings until 8 p.m., until July 27. A lecture on "The Lachish Letters found at Tell Duweir" will be given by Dr. Harry Torczyner, professor of Hebrew philology in the University of Jerusalem, on Tuesday, July 9 at 5 p.m. Admission to the exhibition and lecture is free by ticket.

The Quetta Earthquake

A CORRESPONDENT of *The Times* (June 24) gives some interesting details about the great earthquake of May 31. The zone of destruction extends from Surab in Kalat State to a few miles north of Quetta. Its length is 130 miles and its width 15-20 miles. Even within this area, its effects were variable. In some parts, they spread over the whole width; in others, they were confined to a narrow line, some villages being untouched, while others were destroyed. Quetta lies in an upland valley, 5,500 ft. above the sea, in which earthquakes are rather frequent. The recent shock, however, differed from its predecessors. Though the loss of life was much greater, road and rail communications were not damaged, trees, lamp-posts and most of the telegraph poles remained standing, and electric current was available from the first hour of the shock. The great destruction in Quetta City is traced to the poor quality of the buildings, the erection of earthquake-proof houses having been generally neglected. In the areas of excessive damage, the few buildings that were earthquake-proof remained intact, and not even their chimneys fell.

Tercentenary of the Muséum National d'Histoire Naturelle

THE tercentenary of the Muséum National d'Histoire Naturelle in Paris has been celebrated during the past week, and included a *séance solennelle* on June 25 in the presence of the President of the Republic. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, was the principal delegate from Great Britain, and delivered an address in the name of the foreign delegates who were present. In view of the number of delegations attending the gathering, it was decided to select representative men of science to deliver addresses; Sir Arthur Hill spoke on behalf of the foreign delegates and also as a botanist;

M. Lacroix, a geologist, represented the Institut de France; and M. Caullery, a zoologist, acted on behalf of the French delegates.

Loss of the *Dana*

It is reported in *The Times* of June 24 that the Danish Government's scientific research ship *Dana* sank on June 23 in the North Sea, sixty miles west of Ringkjöbing, Jutland, after a collision with a German trawler. The director of the vessel's scientific work, Dr. A. V. Tåning, and the crew were saved. The *Dana* was well known to men of science and others through the work of the late Prof. Johannes Schmidt, director of the Physiological Department of the Carlsberg Laboratory, Copenhagen, on the migration of eels. It may be remembered that the oceanographical expedition of the *Dana* in 1928-30 was described in an article by Prof. Johannes Schmidt in *NATURE* of March 21, 1931, p. 444 and March 28, p. 487, which included a reproduction of a photograph of the *Dana*.

Floodlighting for the Royal Silver Jubilee

THE floodlighting of London and of many provincial cities has generally been favourably received by the public. The use of coloured light for buildings like the London County Hall and Hampton Court Palace has been severely criticised. The latter development was partly due to the invention of gaseous electric lamps which provide an economical method of producing coloured lights. In the *Illuminating Engineer* of June, P. Good reviews the Royal Jubilee electric lighting. He points out that the floodlighting of a building produces a visual impression which is quite unrelated to the daylight picture and should be so judged. If it has produced a satisfactory impression, it can be justified on artistic grounds. The Horse Guards Parade, illuminated by white light in 1931, was illuminated by violet light in 1935. Although one paper described it at the Jubilee as "a magic castle of palest violet", yet to most people it looked like a temporary structure of plaster and not worthy to be compared with its appearance on the earlier occasion when illuminated by white light. The electrical industry has shouldered the burden of the cost of providing permanent installations at Buckingham Palace, the Horse Guards Parade, the National Gallery and 'Big Ben'. Other interests are paying the cost of the permanent floodlighting of St. Paul's Cathedral. The floodlighting of public gardens has been universally praised. St. James's Park at night illuminated by 300 gas floodlights was a great attraction. When the development of the buildings on the south side of the Thames is completed, it is to be hoped that arrangement will be made for floodlighting and that commercial advertisements will be excluded.

Electric Supply¹/₂ Tariffs in Great Britain

A SERIOUS hindrance to the rapid development of public electric supply in Great Britain is the great inequality in the charges made for electricity in many neighbouring districts. In a paper on public supply

tariffs by J. A. Sumner read to the Institution of Electrical Engineers on February 28, it is concluded, after a careful study of methods of lowering the costs of distribution, that it is not unreasonable to forecast that electricity will be available within the next few years to all consumers at a rate of 0.5d. per unit. Mr. Sumner begins by comparing the costs per kilowatt of a private supply station with that of a public supply. Statistics for the case when Diesel engines are used for the private supply prove that it is the more expensive. It appears that many undertakings are selling electricity for power purposes at a lower rate than is required to compete with the real costs of running private plant. Hence in some cases the domestic consumer is penalised unfairly. It is pointed out that the distinction between 'urban' and 'rural' supply is sometimes unnecessary, as in many cases the capital expenditure for dwellings near the mains is much the same in the two cases. The analysis of the statistics proves that the merging of electricity areas into much larger single districts than at present is necessary for the reasonable standardisation of tariffs. It is possible in this way to balance the inevitable deficit of a newly-developed area against the surplus from the older areas. By this means a uniform tariff can be kept throughout each single large administrative district.

Applications of Photo-electric Control

THE *G.E.C. Journal* (General Electric Company) of February gives an interesting review of electrical progress and development in 1934. Many useful devices are described. Aerodrome obstruction and boundary lights must be switched on when daylight is poor and when darkness approaches in the evening. It is essential that the pilots see the boundary of the aerodrome and any obstructions in the vicinity. The photo-cell has been successfully applied to the control of these lights. At Croydon Airport the switching on of the obstruction light is controlled by a photo-cell amplifier. Another useful application of photo-cells is to control the speed of escalators. The wear and tear of escalators like those in the underground railways of London which are in continuous use is extremely heavy; and renewals and repairs are expensive and, owing to the restricted space, are difficult to carry out. It is desirable to keep the speed low during slack periods at the less-frequented stations when no one is on the escalator. At the entrance to the stairway, a suitable lamp is installed to shine across the footway on to a photo-cell similarly mounted on the other side, just below the handrail. When this beam is interrupted by the entrance of a passenger, the stairway is speeded up in several stages so that the passenger feels no shock, and the escalator continues to run at a high speed until the passenger has time to reach the top. This is attained by a time delay device using a radio valve. If other passengers come on to the stairway before the last one reaches the top, the time delay device resets, so that the high speed continues until the last passenger gets to the top, after which the low speed comes into operation.

Early English Railways

It is known that in the archives of various foreign countries there are documents of interest to students of the history of technology; but seldom is any of this material published. One such document, however, has recently formed the subject of a paper by Mr. P. Zabarinsky published in vol. 4 of the "Archives for the History of Science and Technology". The paper itself is in Russian, but with it is the letter of William Vaughan dated, London, June 14, 1804, and addressed to his Excellency Vice-Admiral Chichagoff, minister of the marine at St. Petersburg. William Vaughan (1752-1850) was a director of the Royal Exchange Assurance Corporation, London, and was much interested in canals and railways and docks. Railways, he said, were common in England and Wales for the conveyance of coals, limestone, ore and such things, and in the London Docks, in which he evidently was particularly interested, railroads and waggons were used in the excavations. Experiments were apparently made at the Docks and in one of these, he said, "In six days of 12 hours, 25 men filled, 24 boys drove and 24 horses conveyed, 3650 cubic yards of earth to the distance of 400 yards and returned the waggons empty". Vaughan described clearly the turntables used on the banks of the Thames, gave estimates of the cost of removing material and made some remarks on the use of railways in Russia.

Work of the Rockefeller Foundation

THE Rockefeller Foundation's report for 1933 presents a tale of vast and varied activities, for the financing of which it had, in pursuance of its mission "to aid in the process of the rationalisation of life", made itself wholly or partially responsible. Its policy in relation to the pressing social problems of the day is guided by the principle that it "can neither remain indifferent to them nor relinquish the support of the fundamentals on which in the long run the control of man's destiny depends". In medical and natural sciences, emphasis has been laid on the problem of mental health and the advancement of the rapidly evolving modern science of man; in the social sciences, on the problem of economic structure and process, international relations and community organisation and planning; and in the humanities, on the encouragement of international cultural understanding and the preservation and interpretation of American culture. Early in the year a sum of a million and a half dollars was set aside for emergency grants for work in connexion with the 'new deal' programmes. Contributions were also made as an emergency measure towards the salaries of eminent scholars displaced for political reasons in Europe and 'adopted' by universities in Europe and the United States. Appropriations during the year totalled about ten million dollars. Among the larger appropriations in the field of the social sciences were: Brookings Institution for Economic Studies, 250,000 dollars; Institute of Economic and Social Research, Paris, 350,000 dollars; League of Nations, 275,000 dollars; National Bureau of Economic

Research, New York, 225,000 dollars; social science research aids, 150,000 dollars; Social Science Research Council, New York City, 265,000 dollars.

Scientific Horticulture

THE third Year-book of the Horticultural Education Association appears under the new title "Scientific Horticulture". It is longer than in previous years, its contents cover a wider field, and go far to justify the change of heading. The presidential address of the Association is by Dr. T. Wallace, and deals with "Science and Fruit-growing", mainly from a historical point of view. Many of the papers in the volume were delivered at a revision course in horticulture arranged by the University of Reading in September, 1934. The practical nature of the lectures of this course is at once apparent—they deal with the highest-grade modern processes in vegetable culture, glasshouse work and bulb-growing, together with descriptions of diseases and pests. They are incorporated as Bulletin 47 of the University of Reading. Articles contributed specially for the year-book include "Commercial Horticulture in Northern Ireland" by W. J. Megaw and E. E. Skillman, "Fruit-tree Spraying Equipment" by J. Turnbull, "The R.H.S. Apple and Pear Conference, 1934" by N. B. Bagenal and R. T. Pearl, "Selection of Soils for Dessert Apple Growing" by B. S. Furneaux, "Twenty-one Years' Fruit Research at East Malling" by R. T. Pearl and R. Hart", "Waste Products in Horticulture, their Utilisation as Humus" by Sir Alfred Howard, and "Research at Rothamsted of Importance in Horticulture" by Miss M. D. Glynne and H. V. Garner. The volume entirely justifies its name, and is a great credit to Mr. R. T. Pearl, its honorary editor. One has the feeling, however, that the bias is on the practical side, and that the newer scientific principles which most gardeners have yet to learn—such as photoperiod, seed stratification and control, plant sterility and the conditions affecting vegetative regeneration—are not expounded. The school garden, the primary stage in horticultural education, receives no notice whatever.

Over-population in America's Deer Herds

IN the Yellowstone National Park, the two great herds of wapati or 'elk' now comprise about 30,000 individuals, and in the northern area the drought-reduced pastures have accentuated a long-standing problem of over-population (Science Service, Washington, D.C.). The fundamental cause of the food scarcity which has resulted is the inevitable restriction of the natural emigrations of the herds, for outside the northern boundary of the Park, the Yellowstone Valley is occupied by cattle ranches. These make an impassable barrier and confine the deer permanently to a quite inadequate portion of what is naturally only their winter range. Over-grazing has altered the vegetation for the worse; most of the nutritious native grasses have been killed out, and their place taken by a weed grass, fox-tail, which apart from its low nutritive value, pierces the gums and permits the growth of a fungus

producing the disease of 'lump-jaw'. Two solutions have been proposed: one that about half the total number of deer should be captured, transferred to a central slaughtering station outside the Park, and killed and distributed to destitute Indians; the other that the captured animals should be set free in areas of Montana where they could be hunted by sportsmen. The second plan is that favoured by National Park officers, but they insist that whatever plan is adopted, it must be carried out promptly, because of the daily increasing seriousness of the emergency.

Meteorology in India

THE report on the administration of the Meteorological Department of the Government of India in 1933-34 has for frontispiece a very good photograph of a tornado which visited Peshawar on April 5, 1933, probably the first photograph to be obtained of this phenomenon in India. The Department has again been hampered by the heavy curtailment of expenditure initiated in 1932, and has nevertheless had to face increased demands for meteorological information on the part of air mail services. It was necessary, therefore, simply to dispense with additional forecasting centres and other facilities demanded by the circumstances, and to carry on with what is described as a skeletal meteorological organisation along each air route. Between April 1, 1933 and March 31, 1934, nearly six thousand weather reports and forecasts were issued to aviators by the departmental forecasting centres at Karachi, Calcutta and Poona and the Royal Air Force centres at Quetta and Peshawar, which are under the technical though not the administrative control of the Department. The report quotes remarks made in a discussion at the Royal Geographical Society of an account of the Ruttledge Mount Everest Expedition that are a strong tribute to the help that can be given to mountain expeditions by local forecasting centres in India. In this case, the Expedition was in touch with Dr. Sen of the Calcutta office for the supply of special forecasts. Scepticism of the value of forecasts that are based largely on observing stations at a comparatively low level was quickly seen to be unjustified, particularly when an abnormally early monsoon was successfully predicted. Among the many activities of the Department, it may be noted that the recently established branch of agricultural meteorology carried on special researches into matters affecting the growth of crops, and that some of the results have already been published.

The Engineer as Planner

IN an article entitled "The Engineer as Planner" reprinted by *Engineering Inspection* of January 1935, Dr. Victor Cofman emphasises the fact that the important factor in the solution of economic and social problems is the application of the spirit and methods of engineering and science to the wider field of human relations, not the particular person who does it. While everyone agrees that the planning of production is the obvious duty of the engineer, opinions are divided as to how far the engineer can

help in the social and economic fields, and it is often pointed out that eminent engineers and men of science do not show particular perspicacity or vision when dealing with social problems. It is essential that those who will have to consider social questions must have a full knowledge of the pertinent facts, and it may be necessary under existing conditions to have a team consisting of sociologists and economists, practical men acquainted with the problems, working together with engineers and men of science acquainted with the methods of science. The opponents of planning take it for granted that planning is synonymous with greater restriction upon individual freedom, but one may plan for freedom and peace just as one may plan for oppression and war. The true opposition is not between planning and liberty, but between arbitrary interference and liberty.

Bibliography of Seismology

THE last quarterly number of this useful work, which is edited by Mr. E. A. Hodgson and published by the Dominion Observatory, Ottawa, completes the twelfth volume and the list of memoirs for 1934. The total number of memoirs referred to during the year is 506, some of them in title only, but many of the more important accompanied by a brief abstract. It is satisfactory to notice that the number of collaborators is increasing, and that new countries are being added to the list, though there is still no representative for Great Britain. The subject-index for the year under more than fifty headings adds greatly to the value of the Bibliography.

The Planetarium

ACCORDING to an article in *The Times* of June 22, accommodation for a planetarium is being included in the plans for rebuilding the centre portion of the Science Museum, South Kensington. It is stated that Germany already has thirteen planetaria, America four, Italy two and Holland, Sweden, Austria and the U.S.S.R. one each. Such an instrument enables celestial bodies to be shown as bright objects on the inside of a large darkened dome, and by means of elaborate mechanism their movements can be demonstrated. The method thus marks a great advance on the orrery, in which the positions and movements of bodies in the solar system are represented in a mechanical model. It will be recalled that the first Zeiss planetarium, erected at Munich, was described and illustrated in *NATURE* of December 27, 1924, p. 937.

Astronomical Phenomena during July

VENUS is a conspicuous object in the evening sky. The planet reaches its greatest eastern elongation on June 30, when the stellar magnitude is -4.0^m , but the planet will continue to increase in brilliance throughout July, the stellar magnitude being -4.2^m on July 31. As both Mars and Jupiter are conspicuous in the evening sky, one can get a very good idea of the ecliptic stretching across the sky, especially

when the moon is visible. Mars, the magnitude of which is $+0.3^m$ at the beginning of July, will decline in brightness by three tenths of a magnitude during the month. The planet will move towards Jupiter, which is near α Libræ. Jupiter's magnitudes are -1.9^m and -1.7^m at the beginning and end of the month respectively. Saturn's Right Ascension is 22^h49^m , about eight hours behind Jupiter and 11^h36^m behind Venus at the end of the month. Saturn's declination being 9° S., it will not be possible to see these four of the five naked eye planets in the same sky from stations north of terrestrial latitude 40° N. during July. Venus is in conjunction with Neptune on July 25 at 06^h G.M.T., Venus being 2.6° S. There is a partial eclipse of the sun, partly visible at Greenwich, on June 30. The eclipse begins at 20^h07^m G.M.T. and fourteen per cent of the disc will be covered at sunset. A total eclipse of the moon on July 16 is also partly visible at Greenwich. The moon enters the penumbra on July 16 at 02^h15^m and leaves the penumbra on July 16 at 07^h43^m , the eclipse being visible on the Atlantic Ocean generally. A further partial eclipse of the sun takes place on July 30; this will be invisible at Greenwich.

Announcements

THE medal of the Society of Chemical Industry has been awarded to Dr. E. F. Armstrong, "for conspicuous services to chemistry". The presentation will be made during the annual meeting and conference of the Society in Glasgow on July 1-6, and Dr. Armstrong will deliver his medallist address on Thursday, July 4, on "The Past, the Present and the Future". Previous recipients of the Society's medal, which is one of the highest awards in the chemical industry, include many well-known men whose work forms the basis of modern science. Notable amongst these are the names of Mr. C. F. Cross, a pioneer of the artificial silk industry, Sir James Dewar, Sir Henry Roscoe, Sir William Crookes, Sir Joseph Swan, Dr. Ludwig Mond, Sir W. H. Perkin, and Mr. John Glover, who was the first to receive the award.

MR. WALTER ELLIOT, Minister for Agriculture and Fisheries, has been elected a fellow of the Royal Society under the special statute which permits the election of "persons who have rendered conspicuous service to the cause of Science, or are such that their election would be of signal benefit to the Society".

MIRZA MUHAMMAD KHAN QAZVINI, a distinguished Iranian savant, has been elected an honorary member of the Royal Asiatic Society in recognition of his many valuable contributions to the cultural history of his country.

THE annual general meeting of the Dechema (Deutsche Gesellschaft für chemisches Apparatewesen E.V.) will be held on July 3-5 at Königsberg, together with the general meeting of the Verein Deutscher Chemiker. The general topic of the meeting will be "German Materials in Chemical Engineering".

UNDER the auspices of the Royal Society for the Protection of Birds, the University of London Animal Welfare Society, and the Society for the Preservation of the Fauna of the Empire, an evening meeting will be held at the Royal Geographical Society, Kensington Gore, London, S.W.7, on July 2 at 8.30, when Capt. C. W. R. Knight will exhibit his new film of South African animals, entitled, "African Adventure". The chair will be taken by the Right Hon. the Earl of Athlone. Admission will be by invitation only, and applications should be made to the R.S.P.B., 82, Victoria Street, London, S.W.1.

THE public health services in Mexico are being reorganised as follows: inspectors of food, water, drainage, epidemics, immigrants and prostitutes are being appointed, co-operative medico-sanitary units are being formed, a sanitary unit has been created in the department of irrigation, and sanitary brigades are being organised for carrying out vaccination against small-pox and typhoid fever.

A FRENCH Medical Aeronautic Association has recently been founded in Paris under the presidency of M. Emile Strohl. It will form a centre for technical and medical documentation, enabling medical men to collect physiological and pathological data connected with aeronautics and flight at high altitudes. It will also facilitate more direct relations between medical men and engineers and technicians for the elaboration of plans concerned with the hygiene of passengers and the transport of the sick and wounded. Further information can be obtained from the general secretary, M. Robert Charlet, 95 rue Jouffroy, Paris, 17^e.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A tutor in mathematics in Westminster Training College, Horseferry Road, London, S.W.1—The Principal (July 4). A resident lecturer in geography in the Saltley Training College for Schoolmasters, Birmingham—The Principal (July 5). An assistant teacher in the Mechanical and Marine Engineering Department of the Liverpool City Technical College—The Director of Education, 14, Sir Thomas Street, Liverpool, 1 (July 5). An assistant lecturer in mechanical engineering in the Manchester Municipal College of Technology—The Registrar (July 9). An assistant in botany in the University of Aberdeen—The Secretary (July 12). A lecturer in pharmacology in the University of Sheffield—The Registrar (July 12). A resident tutor in geography in Borough Road College, Isleworth, Middlesex—The Principal (July 17). A demonstrator in physics in the University of Leeds—The Registrar (July 22). A lecturer in electrical engineering in the Royal Technical College, Salford—The Director of Education, Education Office, Salford. Research assistants to the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester. An assistant lecturer in agricultural biology in Seale-Hayne Agricultural College, Newton Abbot, Devon—The Secretary.

Letters to the Editor

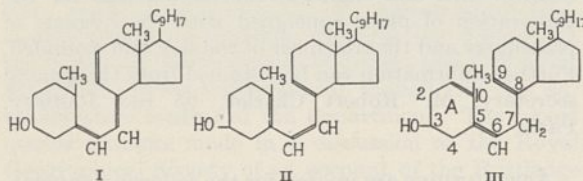
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1078.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Ring Structure of Calciferol

ALTHOUGH calciferol has been shown to be isomeric with ergosterol ($C_{28}H_{44}O$); comparatively little information has hitherto been adduced concerning the detailed structure of this vitamin. According to Windaus, Linsert, Lüttringhaus and Weidlich¹ (compare also Askew *et alia*²) perbenzoic acid titration shows the presence of three ethenoid linkages, from which it follows that calciferol contains a tetracyclic ring structure. In contrast to this observation, Kuhn and Möller³ have found by hydrogenation that calciferol contains four ethenoid linkages, a result which we have confirmed. Calciferol cannot therefore be a tetracyclic compound. Further evidence in support of this view arises from the work of Lettré⁴, who on dehydrogenation of calciferol failed to obtain Diel's hydrocarbon ($C_{18}H_{16}$). Again, this author has demonstrated that tachysterol, which is a direct intermediate in the photochemical conversion of ergosterol into calciferol, is also tricyclic, probably having the constitution I or II.



During the past year, we have been studying the oxidative degradation of both calciferol and calciferol acetate, and have found that, with either chromic anhydride or potassium permanganate, an oily aldehyde is obtained, characterised by its well crystalline semicarbazone, m.p. 242°. Analysis of the latter shows that the aldehyde has the formula $C_{21}H_{34}O$, from which it follows that the disrupted fragment must include the hydroxylated ring A, which consequently cannot be fused to the remainder of the cyclic system as in ergosterol.

Our analytical data for the semicarbazone appear to preclude the formula $C_{21}H_{32}O$ for the aldehyde, indicating that one of the ethenoid linkages of calciferol is present in ring A. On this evidence, formula III is suggested for the vitamin, the formation of the aldehyde $C_{21}H_{34}O$ occurring by simple rupture of the $\Delta^{6,8}$ ethylene linkage. It must be observed that the location of the ethylene linkages at $\Delta^{1,10}$ and $\Delta^{8,9}$ is provisional and remains to be confirmed.

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K. M. SAMANT.
F. S. SPRING.

University,
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¹ *Ann.*, **492**, 226; 1932.

² *Proc. Roy. Soc., B*, **108**, 340; 1931.

³ *Z. angew. Chem.*, **47**, 145; 1934.

⁴ *Ann.*, **511**, 280; 1934.

Colorimetric Estimation of Œstrin in the Urine of Non-Pregnant Women

LAST year we reported the details of a method by which it is possible to determine the œstrone and œstriol content of human pregnancy urine colorimetrically with a reasonable degree of accuracy¹. Since the publication of our paper we have received numerous inquiries as to whether the method can be used for the determination of the œstrin content of urine of non-pregnant women. As this question seems to be one of some general interest, and since in our paper we made no mention of the possibility of using our method for this purpose, we wish to take this opportunity of mentioning briefly our views on the matter.

We have made numerous attempts to estimate the œstrone and œstriol in the urine of non-pregnant women by our colorimetric method, but so far the results have been far from encouraging. Owing to the relatively small amounts of œstrin present it is necessary to carry out the colour reaction in a much larger quantity of extract than we use in the case of pregnancy urines, and hence the colour reaction is carried out in fractions which contain a relatively much higher proportion of non-œstrogenic phenolic substances. The final colour obtained in such tests is a dirty brown instead of a clear pink as is obtained with pregnancy urine extracts. This colour can, of course, be analysed with the Lovibond tintometer, but we do not feel at all confident that the red component of the brown colour can be accepted as a true measure of the œstrin present.

We feel, therefore, that our method as described for pregnancy urine is of little value for the estimation of the much smaller amounts of œstrin present in the urine of non-pregnant women, and we cannot advise its use for this purpose.

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¹ *Biochem. J.*, **28**, 1603; 1934.

Radio-Transmission of Cosmic Ray Data from the Stratosphere

ON April 1, 1935, an apparatus recording cosmic rays by the coincidence method and transmitting the signals by Moltchanoff's radio method, ascended to the stratosphere from the Institute of Aerology at Slootsk (25 km. from Leningrad). The construction of the apparatus and observations with it obtained in an aeroplane flight have already been described¹.

The coincidences were recorded by a relay, which switched on the anode circuit of the radio-oscillator. The radio-signals made in this way were received and counted at the earth's surface by three observers.

Besides the coincidences, the apparatus transmitted at more or less regular intervals the total

number of discharges produced in one of the two counters. For this purpose, switchings were effected in the amplifier by means of a barograph about every 5 minutes. The number of switchings indicated the pressure data.

The apparatus functioned for 58 minutes. Judging by the data of the three observers—which were in fairly good accord—the number of the coincidences produced by the vertical beam of cosmic rays increased with the increase in altitude as follows: up to the altitude of 5 km. by 9 times; up to 7 km. by 18 times; up to 9 km. by 27 times. At greater heights the number of coincidences ceased to increase and the last observation, obtained at the altitude of 12.2 km., even showed a slight fall.

The number of discharges produced in one counter increased up to the altitude of 6 km. by 3.5 times; up to 7.5 km. by 6 times. At greater altitudes (up to 13.6 km.) the number of discharges became too great to be counted, but the intervals were used for tuning the receiver.

The apparatus ceased to function at the altitude of 13.6 km. as soon as the balloons started descending after one of them had burst.

It seems that the method described may be used for the study of cosmic rays at great altitudes, especially in thinly populated localities (near the equator and in the arctic region), where finding self-recording apparatus would present considerable difficulty.

In conclusion, I wish to express my sincere thanks to Prof. P. Moltchanoff for his continued interest, his many helpful suggestions and for the organisation of the flight.

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and
State Radium Institute,
Leningrad.
June 3.

¹*Phys. Rev.*, **46**, 822; 1934.

The Phosphorescence Process as Revealed by the Luminescence from Solid Nitrogen

SOME years ago it was found by me that a number of bands appearing in the afterglow of solidified nitrogen were due to forbidden transitions from metastable, molecular electronic states.

The appearance of bands from forbidden transitions in the crystalline state was explained by the fact that they only appear in the α -form of nitrogen where the molecular axes are fixed in the lattice, while they are absent in the β -form where the molecules rotate¹.

This result would suggest that the rate of decay of the afterglow was determined by the probability for the occurrence of the forbidden transition. This view, however, could not be upheld because the rate of decay sometimes is very slow and does not follow an exponential law.

In order to explain the phosphorescent property (afterglow) of nitrogen, it was assumed¹ that the bombarding rays produced a dissociation of the molecules into atoms which might be neutral or ionised.

Energies corresponding to the elementary process of the chemical reaction were transferred to the molecules in such a way that they were brought into

an excited state with electrons raised to higher levels. In this way the phosphorescence appears to be closely related to chemi-luminescence. The difference is mainly that in the case of phosphorescence the reacting substances have first to be produced by means of radiating quanta.

This view has recently obtained an interesting confirmation by the study of the ϵ -system (Vegard-bands) from solid nitrogen, which some years ago was shown by me to result from the forbidden electronic transition from the $A(^3\Sigma)$ level to the normal state $X(^1\Sigma)$ of the nitrogen molecule.

For the upper state A (bottom state of the first positive group) we know at least 15 vibrational levels. For the ϵ -system no bands are known starting from a vibrational level (A) with quantum numbers n' greater than 7. A few bands were observed for $n' = 7$, and for all values of n' equal to or smaller than 6 a large number of bands were observed.

This sudden break in the vibrational states of the upper ϵ -level was first explained by means of the potential curves for the upper and lower state and by a reasoning similar to that underlying the Franck-Condon theory of intensity distribution of vibrational bands.

Recently, more accurate determinations of the potential functions have shown that this explanation can scarcely be maintained. The abrupt limit of the upper vibrational states, however, can be accounted for, if we assume that the ϵ -system—which also remains in the afterglow—is excited through recombination of normal nitrogen atoms formed during the ray-bombardment.

The dissociation energy of nitrogen has been determined by Herzberg and Sponer², and recently the value $D(N_2) = 7.345$ volts was given by Büttendender and Herzberg³.

The energy necessary to excite the vibrational states $n' = 7$ and $n' = 8$ of the A -level is 7.29 and 7.45 volts respectively. The dissociation energy $D(N_2)$ is just sufficient to excite the $n' = 7$ state, but too small to excite the level $n' = 8$.

The assumption that the ϵ -system afterglow is due to a recombination of nitrogen atoms (chemical reaction) thus accounts for the fact that ϵ -bands occur for $n' = 7$, but not for n' larger than 7.

L. VEGARD.

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University, Oslo.
May 25.

¹ L. Vegard, *Ann. Phys.*, **6**, 487; 1930.

² G. Herzberg and H. Sponer, *Z. phys. Chem.*, **26**, 1; 1934.

³ G. Büttendender and G. Herzberg, *Ann. Phys.*, **21**, 577; 1934.

The Solution, by the Method of Association, of Problems in Inverse Probability

IN his review¹ of a book by Sir Arthur Eddington, Prof. Dingle criticises Sir Arthur's solution of a certain problem in inverse probability. Prof. Dingle proposes a second, simpler, and analogous, although different, problem: If A and D each speak the truth once in three times independently, and A says that D lies, what is the probability that D speaks the truth? He argues that from our knowledge of D , the probability is $1/3$, while from our knowledge of A it is $2/3$, and hence that neither for his problem nor for Eddington's can there be any consistent, correct solution. Yet Prof. Dingle's problem can be regarded

as a problem in statistical association, and admits of one, and only one, solution.

Consider the universe of N events, each consisting of D 's either lying or telling the truth, and of A 's either affirming or denying that D has lied. By the data, the frequency of D 's lying must be $2N/3$, and of his telling the truth, $N/3$. Also by the data, the frequency of D 's lying followed by A 's statement that D has lied must be $2N/3$ times $1/3$, and followed by A 's denial that D has lied it must be $2N/3$ times $2/3$. Likewise, the frequency of D 's telling the truth followed by A 's affirming that D lies must be $2N/9$, and followed by A 's denying that D has lied it must be $N/9$. The accompanying association table exhibits these frequencies; there are no inconsistencies. Out of the sub-universe $4N/9$ in which A says that D lies, D actually lies $2N/9$ times and tells the truth $2N/9$ times; and hence the desired probability is $1/2$. It can be nothing else.

	A says that D lies	A denies that D lies	Total
D lies	$2N/9$	$4N/9$	$2N/3$
D tells the truth	$2N/9$	$N/9$	$N/3$
Total	$4N/9$	$5N/9$	N

Whenever the prior probabilities, as here, are known, any straightforward problem in inverse probability can be recast into the form of an association or contingency table, and must lead to a unique solution. But when one tries to cast into the form of a table of association or contingency a problem in inverse probability for which the prior probabilities are unknown, then the ratios between the total frequencies of the 'cause' rows remain capable of arbitrary adjustment, and no unique probability can in general be found for a particular cause of the observed event. It is only when one or more of the class frequencies vanish in the table that any conclusions can be drawn without a knowledge of the prior probabilities, the argument then becoming a conditional syllogism, *modus tollens*. The method of association not only clarifies the solvable problems in inverse probability, but also demonstrates the logical fallacy involved in almost all applications of the method of inverse probability, when the prior probabilities are unknown.

T. E. STERNE.

Harvard College Observatory,
Cambridge, Mass.
May 4.

¹ NATURE, 135, 451, March 23, 1935.

DR. STERNE'S statement concerning me, that: "He argues that . . . neither for his problem nor for Eddington's can there be any consistent, correct solution", is not quite accurate. I did not dispute that a combination of the data was possible which would allow of a unique result, but I claimed that such a combination did not yield 'probability' according to any significant meaning of the word. If the square of a man's height be divided by the natural logarithm of his age, and the result called his 'affability', this quality can be uniquely determined, but it gives no indication of the reception he is likely to give us. We can either (a) define probability in a purely mathematical way and so obtain a unique solution which may be both consistent and correct (although, in my opinion, Sir Arthur Eddington's solution was neither); or (b) refrain from calling meaningless mathematical functions 'probability', and then obtain two solutions to each problem.

I am willing to discuss the correctness of Sir Arthur Eddington's solution or the significance of his implied definition of probability, but to avoid taking up space unnecessarily, I will wait to hear in which, if either, question Dr. Sterne is now interested.

HERBERT DINGLE.

Imperial College of Science,
S.W.7. May 17.

The Breeding Age of the Yellow-bellied Toad, *Bombina variegata variegata*, Linn.

IN view of the scarcity of data on the age at which *Salientia* begin to breed, and an apparently entire lack of information for the above species, it may be of interest to record that I have to-day seen eggs laid by a pair of these toads which were hatched in my terrarium in 1932. The animals are not yet full-grown, the male measuring 35 mm., the female 37 mm., whilst full-grown toads are about 45 mm.

The males had well-developed nuptial pads last summer, and vigorously attempted to mate with females of all ages, but were prevented from securing adult females permanently by the pugnacity of the older males¹. While I was watching last year, young females always released themselves.

The first sign of sexual behaviour was seen as early as 1933, when an animal only 20 mm. long seized another even smaller, which responded by the typical female release reaction. Behaviour which is sexual in character is not in this species invariably associated with reproduction, as noted for *Bufo bufo* by Hinsche², but it is interesting to find this complex behaviour already in existence in very small toads only one year old.

R. MAXWELL SAVAGE.

19 Derwent Avenue,
N.W.7. June 10.

¹ Savage, R. M., "The Spawning, Voice and Sexual Behaviour of *Bombina variegata variegata*, Linn.", *P. Zool. Soc.*, 4, 889-898; 1932.

² Hinsche, G., "Über Brunst und Kopulationsreaktionen des *Bufo vulgaris*", *Z. vergl. Physiol.*, 4, 564-606; 1926.

Fossils as Indicators of Continental Drift

Most geologists will doubtless agree with Sir Arthur Smith Woodward as to the need for caution in the interpretation of some of the fossil evidence which has been regarded as supporting the hypothesis of continental drift¹. The possibility that fossils referred to the same genus or even the same species may have been developed in different areas (whether from a common or different ancestors) is familiar to those who have been concerned with Mollusca or Brachiopoda, but the implications as regards classification or the value of fossil lists are not so well understood, and Sir Arthur's warning is no doubt timely.

It may be remarked, however, that where, in any system, numbers of similar forms occur in a comparable sequence in widely separated areas, the evidence of a former connexion between the areas is immeasurably stronger; especially is this true where there is a succession of unrelated species belonging to different groups.

These conditions appear to be suitably illustrated in the Upper Carboniferous rocks of western Europe and the eastern States of America, where there is the additional advantage that both flora and non-marine fauna have required practically continuous continental areas for their migrations. As regards the floral succession, in particular, the similarity of the

sequences in the two continents has recently been emphasized by Profs. Jongmans and Gothan². Many European species belonging to all the more important Carboniferous genera occur in Pennsylvania, West Virginia and Kansas in substantially the same sequence as that found in Europe; so close is the agreement that a fairly detailed correlation is proposed.

It may be possible to account for these facts by hypotheses other than that of continental drift, but I would suggest that they are of real importance in any discussion of the problem.

A. E. TRUEMAN.

Geology Department,
University of Bristol.
June 3.

¹ NATURE, 135, 900, June 1, 1935.

² W. J. Jongmans and W. Gothan, "Florenfolge und vergleichende Stratigraphie des Karbons der Östlichen Staaten Nord-Amerika's. Vergleich mit West-Europa". Geol. Bureau Heerlen, Jaarverslag over 1933, pp. 17-44; 1934.

PROF. TRUEMAN, who has specially studied Carboniferous stratigraphy, makes an important addition to my brief article. Following Wegener, I merely mentioned that the theory of continental drift might explain the observed distribution of Carboniferous land and fresh-water life in the northern hemisphere. Prof. Trueman rightly emphasises the significance of the identity of succession of this life in widely separated areas. There can, indeed, be no doubt that identity in succession of whole faunas and floras in two distant regions is much more satisfactory proof of former connexion than the apparent identity of single groups to which I chiefly referred.

A. SMITH WOODWARD.

Statistical Aspect of the Production of Primary Lesions by Plant Viruses

MR. BALD points out in NATURE of June 15 (p. 996) that an attempt to fit the equation $y = N(1 - e^{-ax})$ to data obtained by Samuel and Bald¹ meets with poor success, especially at high dilutions. Samuel and Bald plotted the logarithms of their counts against the logarithms of the dilutions and found that at high dilutions the points lay on a straight line with a slope of 0.6. It may be easily shown that the equation predicts a slope of unity. Data published recently by Price², Chester³, Caldwell⁴ and Beale⁵, give experimental curves with approximately unit slope. This suggests that the discrepancies between Samuel and Bald's experimental counts and values calculated from the equation may in a large part be due to the fact that their data are at variance with other measurements in the literature.

It is true that the equation gives low values at high dilutions, and this was pointed out and a possible explanation offered. It is also true that in this range more plants have to be used to obtain accurate results, since the error is a function of the total number of lesions. The use of log paper for plotting results exaggerates the weight of measurements at high dilutions.

Finally, the sixteen dilution curves fitted to this equation give no indication that its application, at least over a considerable range of dilution, is limited to highly purified virus preparations. Contrary to the idea that only certain cases were chosen, an attempt was made to include all published dilution

curves giving data at high enough concentrations to establish the nature of the curve. The lack of concordance between the dilution data reproduced in Mr. Bald's letter and the curves obtained by other workers indicates that Samuel and Bald's data cannot be used to condemn the validity of the equation.

W. J. YODEN.

Boyce Thompson Institute,
Yonkers, New York.

¹ Ann. App. Biol., 20, 70-99; 1933.

² Contrib. Boyce Thompson Inst., 4, 359-403; 1932.

³ Phytopath., 24, 1180-1202; 1934.

⁴ Ann. App. Biol., 20, 100-116; 1933.

⁵ Contrib. Boyce Thompson Inst., 7, 37-53; 1935.

Coagulation of the Blood as a Chain-Reaction

IN studies on the mechanism of the coagulation of blood, I have found that an active principle of coagulation is formed in the process of coagulation—a principle which can be transferred indefinitely into new plasma without decrease in its activity. In one experiment, 30 γ of an active phosphatide¹ was added to a certain amount of chick plasma. About one minute before coagulation took place, another similar portion of plasma was 'inoculated' with 0.03 c.c. of the first plasma, which was still liquid. Before coagulation of the second plasma took place a third portion of plasma was inoculated; then the coagulation time of the second plasma was recorded. Then a fourth portion of plasma was inoculated from the third, and the coagulation time of the third plasma was recorded. Inoculation of a series of plasmas was continued in this way successively until the original amount of active phosphatide added was diluted to $5 \times 10^{-10} \gamma$, and the experiment was discontinued. The clotting time was practically constant through all the passages.

Further experiments showed that the coagulation-active substance formed during the clotting process of blood plasma increases and disappears almost instantaneously at the very moment of coagulation. The formation of the active principle in the plasma occurs shortly after the 'inoculation' rather slowly, but it increases very rapidly until it reaches an explosion-like rate just before the plasma clots. As soon as the coagulation has taken place, the activity of the principle disappears almost completely. The curve plotted for the formation of active substance during the coagulation process has an exponential form.

A theory of blood coagulation as a chain-reaction finds support in our experimental facts. It is still an open question, on which work is proceeding, whether free radicals are produced during this process. As in chain reactions, we have here an initial reaction and a chain-interrupting reaction. The latter is indicated by the sudden decrease in activity when the substrate is used up. In our case the chain-reaction velocity is exponential, and should belong to such a type as foreseen by Christiansen and Kramers² and proved experimentally by Hinshelwood and Grant³ for the hydrogen-oxygen system. In this kind of chain-reaction more than one active molecule or free radical of the kind which started the reaction may be set free by any of the elementary reactions.

ALBERT FISCHER.

Carlsberg Foundation,
Copenhagen. May 15.

¹ Fischer, A., and Hecht, E., Biochem. Z., 269, 115; 1934.

² Christiansen, J. A., and Kramers, Z. phys. Chem., 104, 451; 1923.

³ Hinshelwood, C. N., and Grant, G. H., Proc. Roy. Soc., A, 141, 29; 1933.

Oscillations of Hollow Quartz Cylinders

WITH reference to the letter by Ny Tsi-Zé and Tsien Ling-Chao published in *NATURE* of August 11, 1934 (p. 214), it is interesting to note that annular quartz rings cut in a plane perpendicular to the optic axis were investigated by Giebe and Scheibe¹ in 1928, by the luminous resonator method. Such a ring, oscillating in its fundamental longitudinal mode, was also made by Dye, and was afterwards developed to form the primary standard of frequency at the National Physical Laboratory. More recently, similar rings oscillating in an overtone longitudinal mode have been investigated in an attempt to incorporate the most successful features of the different types of quartz oscillators which have been developed to form frequency standards in this and other countries.

In the type of ring oscillator now being investigated, the exciting electrodes consist of two brass cylinders around the inner and outer edges of the ring. An overtone circumferential mode of vibration having six nodes is employed. The ring may be mounted rigidly at the nodal points so that movements within the electrodes are completely eliminated. By adjustment of the width of the ring, that is, the difference between its internal and external radii, it has been found possible to reduce the temperature coefficient of frequency over a limited range to a few parts in a hundred million, which is a hundred times smaller than the usual coefficient for longitudinal vibrations of quartz. The temperature at which the low coefficient is obtained can be adjusted to any desired value.

National Physical Laboratory,
Teddington. May 16.

L. ESSEN.

¹ Giebe and Scheibe, *Elektrische Nachrichten-Technik*, 5, 81; 1928.

Plasticity of Crystals of Sylvine

ATTENTION has frequently been directed to the plasticity of crystals of rocksalt when immersed in water. Some see the cause of the plasticity in the removal of surface layers with their cracks and defects. Others suppose that water penetrates the crystal lattice and acts as a lubricant. It is interesting to observe the behaviour of crystals in a state of recent formation from solution or melt. For this purpose I have made some experiments with sylvine (KCl).

I find that crystals of sylvine which, like those of rocksalt, are brittle under normal conditions, become plastic after treatment with water. At high temperatures (700°–780°) sylvine possesses noticeable plasticity: it is deformed by small loads. The mobility of deformation may be adopted for calculation of the viscosity of the crystals, although variable in its value.

Crystals taken out of the solution in which they are grown and wiped with filter paper are very plastic at first. If exposed to the air without any special drying they become fragile in a few hours.

Sylvine crystallises in the form of parallelepipeds, sheets and fibres; sometimes also in skeleton forms. Sheets of 0.1 mm. thickness are so plastic that they

can be bent so as to form tubes. Fibres 0.2–0.3 mm. in thickness and up to 10 cm. in length bend under their own weight.

Consequently sylvine crystals on forming either from melt or from solution possess considerable plasticity, and must yield easily to mechanical stresses. This may explain the frequent occurrence of bent and twisted crystals.

E. W. ZEHNOWITZER.

Leningrad.

Electrolytic Method for obtaining Bright Copper Surfaces

It is possible to polish a copper surface electrolytically by making it the anode in an aqueous solution of orthophosphoric acid at high current density (minimum 25 amp./dm.²). This mode of polishing is particularly suitable for metallographic

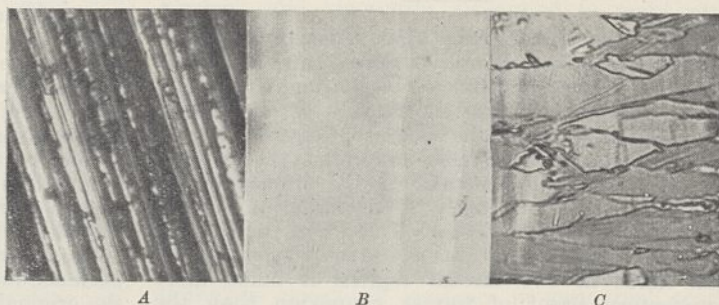


FIG. 1. $\times 400$.

examinations, and has been used for the examination of copper deposits in presence of various colloids.

The specimen is first roughly treated with emery paper, then cleaned cathodically in an alkaline solution and finally inserted for about two or three minutes in an aqueous solution of orthophosphoric acid, 50 per cent by volume of the commercial product, specific gravity 1.71. The current density was maintained at 60 amp./dm.² of the total surface. The solution had to be cooled to avoid considerable increase of temperature. Any metallic plate will serve as cathode. Gas being vigorously evolved, a rotating anode helps to get a uniform effect. The microscopic analysis of the surface shows the lines produced by emery polishing (Fig. 1, A) to vanish completely (Fig. 1, B) and an attack by means of the usual agents gives the image reproduced on Fig. 1, C. Should this attack be insufficient, the anodic polishing can be repeated for about thirty seconds to obtain a fresh surface ready for another attack. This method is much more rapid and more economical than polishing by alumina.

P. A. JACQUET.

Laboratoire d'Electrochimie de
l'Ecole Pratique des Hautes Etudes,
Paris (5^e).

Twinning in Alpha Iron

IN a letter to *NATURE* of June 1, A. B. Greninger reports having observed twinning in alpha iron. Slow cooling through the A_3 temperature produced twins of the banded type, whilst deformation and recrystallisation resulted in twins which were seldom

banded. It was shown by me in 1928¹ that certain strained and annealed alpha iron crystals contained twins lying along (112) planes, and furthermore I cited evidence suggesting that twinning in alpha iron might sometimes be associated with twinned gamma iron from which it had cooled. It has also been observed^{2,3} that on annealing a deformed single crystal of alpha iron the polygonal aggregate obtained gives pressure figures indicating uniform orientation, and it seems likely that this may also be associated with twinning.

The general importance of annealing twins to the metallurgist has hitherto been the evidence which they afford of the previous history (cold-working and annealing) of the specimen. Unfortunately only X-ray methods can be relied upon to detect them with certainty in alpha iron, and now apparently some method of distinguishing between the two processes of origin is required.

An interesting practical point may be connected with this twinning behaviour. Mild steel tinplate is said to be more ductile and to have better Erichsen values when cold-rolled and annealed than when hot-rolled and normalised. The former process probably produces a more highly twinned structure, which for crystallographic reasons would tend to deform more easily.

HUGH O'NEILL.

L.M.S. Research Laboratory,
Derby. June 5.

¹ *J. Iron and Steel Inst.*, **117**, 689.

² H. O'Neill, *T.A.I.M.E.* (Iron and Steel Div.), 229; 1928.

³ L. B. Pfeil, *Carnegie Mem.*, *J. Iron and Steel Inst.*, 153; 1927.

Dissociation Energy of the CO Molecule and the Sublimation Heat of Carbon

THE direct experimental values of the sublimation heat L of carbon obtained by several authors¹ lie between 139 and 177 kcal. An accurate value can be deduced from the energy of dissociation D_{CO} of CO into normal atoms, since the well-known relations (at 0°K.):

$$\begin{aligned} C_{\text{diam.}} + \frac{1}{2}O_2 &= CO + 27.6 \text{ kcal.} \\ CO &= C(^3P) + O(^3P) - D_{CO} \\ C(^3P)_{\text{gas}} &= C_{\text{diam.}} + L \\ O(^3P) &= \frac{1}{2}O_2 + 58.7 \text{ kcal.} \end{aligned}$$

lead to

$$L = D_{CO} - 86.3 \pm 0.2 \text{ kcal. (86.3 kcal. = 3.74 v.e.)} \quad (1)$$

The value of D_{CO} was hitherto not exactly known. However, the predissociation in the $CO(B^1\Sigma)$ level² gives the upper limit: $D_{CO} \leq 11.07$ v.e. We obtain the lower limit in the following way: for the upper level ($A^1\Pi$) of the fourth positive CO bands, which lies 7.99 v.e. above the ground ($X^1\Sigma$) state, 16 vibration levels (2.41 v.e.) are observed, corresponding to $7.99 + 2.41 = 10.40$ v.e. above the ($X^1\Sigma$) state. This value is a lower limit for D_{CO} , if CO ($A^1\Pi$) dissociates into normal atoms. By linear extrapolation (which gives in many cases values which are too high) of vibration levels of the ($A^1\Pi$) state we obtain about 4 v.e. ($v'_{\text{max.}} = 43$), that is 12 v.e. above the ($X^1\Sigma$) state. The ($A^1\Pi$) state could be formed only from atoms of equal multiplicity: (a) $C(^3P) + O(^3P)$ or (b) $C(^1D) + O(^1D)$ or (c) $C(^1S) + O(^1D)$, etc. Already the interpretation (b) leads to $D_{CO} \leq 8.79$ v.e. = $12 - 3.21$ v.e. (3.21 v.e. being the sum of excitation energies of $C(^1D)$ and $O(^1D)$). According to (1), then $L \leq 5.05$ v.e. (116 kcal.); this

value must be excluded as being beyond the errors of determinations of L (it seems also too near to $L = 113$ kcal. for Fe). Consequently, we must assume that $CO(A^1\Pi)$ dissociates into non-excited atoms (if it is really a singlet state) and D_{CO} lies between 10.4 v.e. and 11.07 v.e. D_{CO} is certainly much nearer to the upper limit, since at the 16th vibration level the convergence is still not sufficiently advanced. $D_{CO} = 11$ v.e. = 253.6 kcal. is probably not in error by more than 0.1 v.e. Therefore we obtain $L = 7.26$ v.e. = 167 kcal. The restriction of the error limits to 0.1 v.e. = 2.3 kcal. eliminates one of the most important uncertainties inherent at calculations of formation energies of carbon compounds³.

P. GOLDFINGER.
W. LASAREFF.

Laboratory of Physical Chemistry,
University, Liège.
May 23.

¹ H. Kohn and M. Guckel, *Z. Phys.*, **27**, 305; 1924. A. L. Marshall, and F. J. Norton, *J. Amer. Chem. Soc.*, **55**, 431; 1933.

² D. Coster and F. Brons, *Physica*, **1**, 155; **1**, 634; 1934. D. N. Read, *Phys. Rev.*, **45**, 752; 1934. R. Schmid and L. Gerö, *Z. Phys.*, **93**, 656; 1935.

³ L. Pauling and J. Sherman, *J. Chem. Phys.*, **1**, 606; 1933. C. T. Zahn, *J. Chem. Phys.*, **2**, 671; 1934. W. Lasareff, *J. Phys. Chem.* (in the press) and *Physica* (in the press). P. Goldfinger, W. Lasareff and M. Letort, *C.R.*, **200**, 1593; 1935.

In the letter above, which I had the opportunity of reading in manuscript form, Goldfinger and Lasareff calculate the heat of dissociation of CO on the basis of thermochemical and spectroscopical data and give as the most probable value 11 v.e. with a possible error of not more than 0.1 v.e. I want to direct attention to the fact that this may be independently checked by the results of the investigation by Schmid and Gerö¹, who observed in addition to the known predissociation in the $v = 0$ level of $B^1\Sigma$, occurring at $J = 38$, another predissociation (breakdown of rotational structure) occurring at $J = 18$ of the $v = 1$ level. The application of the reasoning of Herzberg² to this case shows that the lower limit of the asymptote of the perturbing electronic level is situated only 40 cm.^{-1} below the upper limit, equivalent to 11.062 v.e., and that its real position therefore is 11.06 ± 0.005 v.e. This would represent the dissociation energy of CO if the asymptote really corresponds to the dissociation in $C(^3P) + O(^3P)$. The alternative possibility that it would correspond to dissociation into $C(^1D) + O(^3P)$ and that therefore $D_{CO} = 1.105$ v.e. will be discussed in detail elsewhere.

B. ROSEN.

Institut d'Astrophysique,
Université de Liège.

¹ Schmid and Gerö, *Z. Phys.*, **93**, 656; 1935.

² Herzberg, *Ann. Phys.*, **15**, 677; 1932. **21**, 577; 1935.

Research and the Library

WE are in substantial agreement with the views expressed by Mr. G. E. H. Foxon in NATURE of June 8, except that he has misinterpreted the penultimate paragraph of our original article¹, as reference to it will show that it was not our intention to burke scientific debates. The inclusion of these would not be overlooked by an editorial board of the calibre envisaged by us. Our point was that votes

of thanks and such superfluous matter or padding should be excised.

On the form of a paper, we feel that the introduction is often unnecessarily lengthy, except in the 'key paper' advocated by us, and ruthless editing could reduce its length in subsequent papers without sacrifice of intelligibility. We agree that the incomplete paper could be checked, and our regret is that it does get printed owing to inefficient editing.

We are wholly on the side of Mr. Foxon on the subject of genuine research and the problem of the young worker who is merely adding professional qualification. We feel that should publications adopt our recommendations genuine research would flourish, and the problem of the 'kilograms' of contributed papers be solved, by the printing of good quality material with consequent economy of time, cost and bulk.

J. L. BERRY.
WILFRID BONSER.

University of Birmingham.

¹NATURE, 135, 664, April 27, 1935.

Prediction of Earthquakes

As Mr. Broughton Edge reminds us¹, an earthquake is preceded by the building up of stress conditions. The most direct way of determining stress is by the observation of strain, and the amounts of strain which have been observed prior to an earthquake have been very large.

The methods of interferometry would permit observation of such strain locally at small expense, and the surface stress throughout a large area might therefore be very readily mapped out and a continuous record made. Such observations could scarcely fail eventually to result in foreknowledge of these disastrous occurrences.

F. TWYMAN.

Adam Hilger, Ltd.,
98 King's Road,
London, N.W.1.
June 17.

¹NATURE, 135, 997, June 15, 1935.

Points from Foregoing Letters

FURTHER steps towards the elucidation of the chemical structure of vitamin D (calciferol) are reported by Prof. I. M. Heilbron, K. M. Samant and F. S. Spring. They suggest a three-ring formula and indicate the probable position of the double bonds and of the hydroxyl group.

Prof. G. F. Marrian and S. L. Cohen report that their colorimetric method for the estimation of the sex hormone, oestrin, in human pregnancy urine, is not applicable to the detection of that substance in the urine of non-pregnant women, where it exists in much smaller amounts.

Experiments with a cosmic ray detecting apparatus sending its own radio signals as it ascends into the stratosphere are reported by S. Vernoff. The apparatus is likely to be useful in thinly-populated localities where the subsequent finding of self-recording apparatus sent up by unmanned balloons would present considerable difficulties.

The Vegard bands in the afterglow or phosphorescence of nitrogen are, according to Prof. L. Vegard, due to a recombination of nitrogen atoms, derived from molecules dissociated by the bombarding rays. This view links phosphorescence phenomena with chemi-luminescence.

Dr. T. E. Sterne suggests that if the apparently inconsistent problem in inverse probability, recently proposed by Dr. Dingle, is regarded as a problem in association, it is seen to be really self-consistent, and that the method of association reveals the nature of the fallacy involved in the use of inverse probability when the prior probabilities are unknown. Dr. Dingle, while admitting that such a combination, giving a unique result, is possible, claims that it has nothing to do with probability.

Mr. R. Maxwell Savage records that the toad, *Bombina variegata variegata*, has laid eggs in captivity at the age of three years. Males showed vigorous sexual behaviour at two years old, and signs of typical sexual reactions were seen in animals only one year old.

While agreeing with Sir Arthur Smith Woodward's warning that similar fossil animals may have developed independently in widely separated areas and are,

therefore, no definite proof of Wegener's continental drift theory, Prof. A. E. Trueman points out that identity of succession of similar forms in comparable sequence in the Upper Carboniferous rocks of western Europe and eastern America does provide strong support for the theory.

An active principle responsible for the coagulation of the blood is described by Dr. Albert Fischer. The active substance is apparently formed during the clotting process of the blood plasma and disappears almost instantaneously at the very moment of coagulation; it can, however, be transferred indefinitely into new plasma without decrease in its activity.

An improved type of cylindrical quartz oscillator (used in television), with a temperature coefficient of frequency a hundred times less than the usual coefficient for longitudinal vibrations of quartz, is described by L. Essen.

Prof. E. W. Zehnowitzer finds that crystals of sylvine (KCl), like those of common salt, lose their brittleness after treatment with water. Such crystals recently prepared from a molten state similarly possess considerable plasticity, which may explain the frequent occurrence of bent and twisted crystals.

A new, rapid and economical electrolytic method of preparing polished copper surfaces for metallurgical examination is illustrated by P. A. Jacquet. The copper is made the anode in an aqueous solution of orthophosphoric acid, and a high current density is used.

Hugh O'Neill discusses the twinning of crystals of alpha iron, which is soft and magnetic and the chief constituent of wrought iron, as evidence of previous history (cold-working and annealing) of the metal; he recalls his former suggestion that twinning in alpha iron might sometimes be associated with twinned gamma iron (non-magnetic) from which it had cooled.

The heat of sublimation of carbon, a constant used in calculating the energy of formation of carbon compounds, has a value of 167 k.cal. according to calculations by P. Goldfinger and W. Lasareff. They deduce its value from the energy of dissociation of carbon monoxide into normal atoms, as determined by thermochemical and spectroscopical methods.

Research Items

'Diminutive' Flint Implements. Diminutive flint implements—to be distinguished both by their form and their cultural associations from the microlith of upper palaeolithic and early neolithic age—have been found in pliocene and pleistocene deposits in Suffolk, Lincolnshire and the Thames Valley. In describing their characteristics, Messrs. J. Reid Moir and J. P. T. Burchell point out (*Antiquaries J.*, 15, 2) that on two previous occasions only, so far as they can ascertain, have similar implements been recorded, the first being by M. E. Pittard in 1908 in the valley of the Rebières, Dordogne, and the second in the account of the implements found with the relics of Peking man in the cave of Chou Kou Tien. These diminutive implements do not show the characteristic forms of the microlith, but are rather diminutive forms of the industries with which they have been found in association. As regards their age, the specimens now described belong to four different periods, of which the latest is much older than upper Aurignac. The earliest of the Suffolk implements are of pliocene age and pre-palaeolithic type, coming from the Suffolk bone bed beneath the Red Crag. Next comes St. Acheul and early Le Moustier series from the 'Middle Glacial Gravel' (held to be of second Interglacial age) underlying the upper chalky boulder clay. Next are implements from the Upper Chalky Boulder Clay; and lastly those from the Lower Floor of late Le Moustier or early Aurignac age in Bolton and Co.'s brickfield, Ipswich. The Lincolnshire implements come from the 100 ft. and 50 ft. raised beaches below the brown boulder clay, and are middle to upper Le Moustier; and those from the Thames Valley come from the base of the 50 ft. terrace of post-Combe rock age, while others may be derived from the Boyn Hill 100 ft. terrace and possibly from the 50 ft. terrace of pre-Combe rock age. The maximum length of these flints is two inches and the minimum is $\frac{3}{8}$ in. Their purpose seems beyond conjecture.

Equatorial Islands of the Pacific. In 1924 the Whipoorwill and Kaimiloa Expeditions of the Bernice P. Bishop Museum, Honolulu, visited the low coral islands lying within six degrees of the equator which, though uninhabited when discovered by Europeans, are supposed to have served as resting places for the Polynesian voyagers in their journeys. The results of the search for archaeological remains have been recorded by Mr. Kenneth P. Emory (*Bull.* 123, Bernice P. Bishop Museum). On Howland Island, previously recorded excavations and mounds were examined, the most important being an irregular crescent-shaped pile of coral and shells, 18 ft. long, and a low circular enclosure. On Washington Island no artefacts of local origin have been found; but ancient stone-wall enclosures appear on the south coast. On Fanning Island an enclosure of dressed stones and a tomb near the cable station were inspected, but no excavation was permitted. The enclosure agrees in structure with Tongan and Tongarevan marae, but, outside these, has no parallels in Polynesia. Similar stone vault burials are widely distributed in Polynesia and are especially characteristic of Tonga. In Christmas Island all the principal sites, except those on the east coast, were visited. They consist of house sites and platforms,

coconut groves and ruins, and graves. There is no definite evidence of Polynesian settlement, and two village sites have yielded no artefacts, indicating temporary occupation. Petroglyphs are too indefinite to be associated with any particular area. The traces of Polynesian visitors belong to different periods and come from various directions. Jarvis Island produced no Polynesian ruins or artefacts. Three well preserved marae were found on Malden with smaller marae and a number of ruins. They resemble strikingly those of Raivavae and suggest an occupation of several generations. No archaeological remains are reported from Starbuck Island.

The Termite Population of a Mound Colony. Termites of the species *Eutermes exitiosus*, Hill, form mound nests in parts of Australia, and an attempt has been made to ascertain the total number of individuals inhabiting such a colony. In carrying out such an estimation, there has to be taken into account the fact that all the termites living in a particular mound are never present within such a mound at any one time. Messrs. F. G. Holdaway, F. J. Gay and T. Greaves have recently published an article embodying the results of their investigations of this subject (*J. Coun. Sci. and Ind. Res.*, Australia, February, 1935). The observation that the number of individuals of the afore-mentioned species present in a given mound is greatest during the cooler months of the year led them to study the population of the mounds during such periods. Four mounds, not differing greatly in size, were dug up and their populations calculated by a method of weighing. It was estimated that 65–70 per cent of the termites in the mounds were encountered and, on this basis, the actual population was calculated to range from 747,000 to 1,806,500 individuals. The proportions of individuals in the most populous mound worked out as 1,561,400 workers, 201,000 soldiers and 44,100 nymphs. The size of the mound in question was 3 ft. 4 in. \times 3 ft. 5 in. \times 19 in. high.

Wing and Halter of *Tipula*. J. Zaćwiličowski (*Bull. Internat. Acad. Polonaise Sci. Lettres*, 2, Oct.–Dec. 1934) has investigated the innervation and the sense-organs of the wings of one of the daddy long-legs, *Tipula paludosa*, employing vital staining by rongalite white for the nerve elements. He describes the distribution of the sense-hairs, sense-bristles and sense-papillae on the wing and the three chordotonal organs which are present near the base of the wing. He regards the innervation as more primitive than that of any other dipterous wing hitherto described and as indicating that *Tipula* is very nearly related to *Panorpa*, the nerves and sense organs of the wing of which he described in a paper in the same journal in 1933. In a further paper the author describes the results of corresponding investigations by similar methods on the halter of *Tipula paludosa*, on which are sense-hairs of two types, sense-papillae arranged in five groups, and six chordotonal organs. After discussing the distribution of the nerves in the halter and the homologies of the parts of the wing and the halter, he concludes that the halter, in contradistinction to Buddenbrock's view (1919), is to be regarded as a rudimentary wing with a remarkable

accumulation of sense organs, in consequence of which it plays a notable part in the sensory life of the fly. On the basis of these morphological investigations the halter has assumed no new function, that is, none foreign to the wing, from which it has arisen. The halter is a transformed hind-wing.

Water Requirements of Indian Crop Plants. Following the methods of the American investigators, Briggs and Shantz, Prof. B. N. Singh and two research students, R. B. Singh and K. Singh, have examined the water requirements of fifty-seven species and varieties of cereals, cotton, sugar cane, etc., when grown at the experimental station of the Institute of Agricultural Research, Benares Hindu University (*Proc. Indian Acad. Sci.*, 1, No. 9, March 1935). The plants are grown in pots with carefully controlled water supply and, in the end, the total water transpired is divided by the dry weight produced, the roots being included in the yield, as was not done by the American experimenters. The amount of water available in these experiments seemed to control the yield of the varieties; the most efficient varieties, it is concluded, have a relatively short life-cycle when the use of water is reduced to a minimum. It is suggested that, under Indian conditions, these efficient varieties should be grown so that the number of irrigations might be controlled and thus the cost of production diminished. In their demand for water, sugar cane crops proved most greedy, and then in order came tobacco, cotton, rice, potato. Other cereals, wheat, oats, barley, as also linseed, pea and mustard, had a much lower water requirement.

Gondwana Deposits of Brazil. Many new observations on the Gondwana rocks of southern Brazil are recorded in a paper by V. Oppenheim entitled "Rochas Gondwânicas e Geologia do Petróleo do Brasil Meridional" (*Min. Agric., Dept. Nac. Prod. Min. Bol.*, No. 5. Rio de Janeiro, 1934). The author gives a new stratigraphic scheme along the lines of those of White and Oliveira, recording for the first time the existence of several unconformities within the Santa Catarina System. Especially notable is the one between the Lower and Upper Strada Nova, the lower member considered to be Permian while the upper one, with the pelecypod fauna described by Cowper Reed, is of Upper Triassic age. There seems also to be an unconformity between the Upper Strada Nova and the Rio do Rasto group as well as a local one between the last named group and the Botucatú sandstone. The author regards the Bonito group (lower member of the Tubarão series) as partly glacial, stating that in several localities coal seams are known underlying glacial deposits that seem to be *in situ*. These observations are of great interest because until now all the glacial deposits of Southern Brazil were indiscriminately referred to the Itararé series. It is shown that the tectonic structure of the Paraná Basin corresponds in a general sense to a geo-synclinalorium with the character of a 'Graben' between Lat. S. 18° and 24°, and of a monoclinical between Lat. S. 24° and 33°. The internal structure is one of faults *en échelon* from east to west, intensively developed in successive degrees of small individual throw. The paper is illustrated with more than thirty geological profiles based on field observations and deep boring, and with a geological map to the scale of 1 : 2,750,000 comprising the Brazilian States of Rio Grande do Sul,

Santa Catarina, Parana, São Paulo and parts of Minas Geraes, Goiaz and Matto Grosso as well as the neighbouring Republic of Uruguay and parts of Paraguay.

Extraction of Oil from Oil Shales and Torbanites. Great Britain is at the present time importing most of its requirements of petroleum and petroleum products. Economically, this position may be sound since there are adequate resources of these commodities for some time to come. Politically, however, such dependency on foreign supplies is dangerous, as was demonstrated during the War. For this reason, attention is being constantly focused on the possibility of obtaining liquid fuel from domestic resources. Hydrogenation of coal, tar or creosote is being carefully investigated; also production of liquid fuels by synthesis from carbon monoxide and hydrogen, by fermentation to alcohol vegetable products, by polymerisation of certain hydrocarbons, and extraction of oil from oil shales, sands and torbanites. Messrs. Salermo, Ltd., of 14 Waterloo Place, S.W.1, have done a considerable amount of research in connexion with the last possibility, and have recently issued a technical pamphlet on the subject. A brief account is given of the characteristics of oil shales and torbanites, their distribution and possible origin. From this it becomes apparent that oil-yielding products vary substantially in chemical and physical properties, and it is not possible to specify one plant as adequate for the extraction of oil from all types of material. The firm has, however, by dint of prolonged study of the 'primary variables', namely, rate of heating, temperature and carbonisation and rate of removal of oil vapours and gas, achieved a system of retorting which approximates closely to established principles. The Salermo retort and process are clearly described and illustrated in the pamphlet already referred to, and in addition carbonisation results are furnished of representative materials after treatment in this plant.

Volumetric Determination of Copper. The iodometric determination of copper depends on the addition of a soluble iodide which precipitates cuprous iodide and liberates iodine; the latter is titrated with thio-sulphate. It is well known that the method has certain difficulties. The reaction $2\text{CuI}_2 = 2\text{CuI} + \text{I}_2$ does not go quite to completion when the iodine is titrated, and some iodine appears to be absorbed by the precipitated cuprous iodide, which is always coloured instead of white at the end point. The addition of potassium thiocyanate with the iodide, which precipitates cuprous thiocyanate instead of iodide, does not give good results, because both iodine and thiocyanogen are liberated simultaneously and react with each other. H. W. Foote and J. E. Vance (*J. Amer. Chem. Soc.*, 57, 845; 1935) obtain better results if the titration with thio-sulphate is first carried out to the point when starch is added. After adding starch, the titration is continued nearly to the end point usually observed, when about 2 gm. of ammonium thiocyanate is added for 50 c.c. of solution. The blue colour immediately deepens. When the thiocyanate has been dissolved by stirring, the titration is finished. The end point is exceedingly sharp and the precipitate is white instead of slightly brownish, probably because the cuprous iodide is transformed, at least on the surface of the particles, into thiocyanate and the small amount of adsorbed

iodine is liberated. Considerable changes in hydrogen ion concentration have no measurable effect on the accuracy. The reaction takes place in stoichiometric proportions within one part in 1,600.

Shock Wave of an Explosion and Rate of Detonation. When an explosive is fired from a borehole with no filling above the charge, it not only emits flame and a considerable volume of gases, but there is also a 'shock' wave transmitted to the surrounding atmosphere. This produces the concussion effect felt in the ear to a varying extent when 'shots' are fired. D. B. Gawthrop has described experiments to show how the shock wave is affected by the rate of detonation (*J. Franklin Inst.*, April). It advances in the air ahead of any forward movement of the gases from the explosive. If in unconfined space it expands spherically in all directions, its velocity diminishing, and it ultimately degenerates into a normal sound wave. The paper describes a research made to determine the velocities of the shock waves sent out by the explosives at widely differing rates of detonation. Definite indications had been previously obtained that the rate of detonation is a factor which affects the safety of the explosives when fired in the presence of firedamp. It was found that with a certain charge the average speed of the shock wave at a distance of 15 cm. from the mouth of the borehole was 1,135 metres per second, but at 135 cm. it was only 350 m.p.s. Quadrupling the weight of the charges, the corresponding speeds were found to have increased to 1,670 and 450 m.p.s. respectively. The experiments made showed that the rate of detonation had no effect on the velocity of the shock wave sent out. As the weight of the charge increases there is a decrease in safety in firedamp, and we now know that there is also an increase in the velocity of the shock wave.

Preservative Treatment of Wooden Sleepers. As a result of the work and researches of Sir Ralph Pearson and others, carried on by successors, *Forest Bulletin No. 85* (Delhi: Manager of Publications, 1934) has recently appeared entitled "A Record of the Results obtained with Experimental Treated Sleepers laid in Indian Railways between 1911 and 1916", by S. Kamesam of the Wood Preservation Section of the Research Institute at Dehra Dun. Between 1911 and 1916 some thousands of wood sleepers of several species of Indian timbers were treated with different preservatives at Dehra Dun and then laid down by the railway authorities in the various railway systems of India. As a result of these experiments, the confidence of Indian railway engineers in wood preservation has been steadily and definitely strengthened. Coal-tar creosote, as in other parts of the world, has given excellent results. The Indian railways are thoroughly satisfied with a creosote-crude oil treatment for their sleepers, and it has become the standard treatment during the last decade. In reviewing, however, the results obtained in the present series of test sleepers, and considering that creosote costs in India more than twice as much as it does in Europe, Mr. Kamesam states that there are great potentialities for cheaper preservatives, such as arsenic, on the basis of wood preservative "efficiency for a unit of cost". Tabular statements record the number of the sleepers laid in different parts of India (except the south), and give data as to the method of treatment and their subsequent life-history.

Pulsation in Electric Mains. We have now throughout Britain hundreds of very powerful dynamos (alternating current generators) all working practically in step with one another although the frequency is 50 per second. In the early days of electricity supply, John Hopkinson found mathematically that two alternators could run in parallel with one another, a slight falling out of step being accompanied by powerful forces tending to make them fall into step again. Practical experience has shown that instability may arise from the nature of the load, and if we have many machines working in parallel and interconnected by long mains, serious pulsations of the current may be set up which may open the circuit breakers and interrupt the supply. In a paper by W. D. Horsley read to the Institution of Electrical Engineers on March 28 an investigation is made of different conditions of operation which may give rise to these pulsations. The value of automatic voltage regulation is discussed and it is shown that it is of considerable value in increasing the load limit and stability of an alternator. When it is used, the load of the system is only limited by the values of the constants of the transmitting line. In America the corresponding problem is more difficult because the power stations have to be interconnected by very long transmission lines. In addition, they have large hydro-electric plants linked together with steam generating plants. In designing the British grid full advantage was taken of experience gained abroad. Luckily the lightning problem is not a serious one in Great Britain. The most severe types of disturbance we suffer from are due to faults in the network, and so the quicker the speed of operation of protecting apparatus and switch gear the better.

A Test Recorder for Electric Lamps. The manufacturer of incandescent lamps is obliged, in order to control the quality of his product, to make a large number of life tests of individual samples. In order to get the maximum benefit from these tests, they have to be made on a large scale under expert supervision. The large consumption of electric energy during the 1,200-hour test is quite a serious addition to the cost of manufacture of the lamp. It has now been found that by increasing the voltage applied over the rated voltage of the lamps, the time necessary for the complete test can be considerably shortened. For example, the life-history of a batch of lamps which would normally average 1,200 hours burning could be found in twelve hours. In the *G.E.C. Journal* of May, G. Chelioti gives a full description of the test recorder used by the Osram-G.E.C. works. This works has had considerable experience of the shortened method of testing, but before the introduction of the recorder it was found that the necessary continuous supervision for the 12-hour test put a great strain on the supervisors, as unless the time at which each of a long row of lamps burns out was recorded with fair accuracy, large errors arose. Human frailty is a large factor as the work is extremely monotonous, and it is practically impossible to check the records. Hence an electrical recorder which would relieve the worker of this dreary task and give a permanent record of unimpeachable authority was welcomed. In the full-life test at the rated voltage, it is customary to make checks every 12 hours; in the abbreviated test they are made every six minutes.

The David Dunlap Observatory, Toronto

ALTHOUGH most of the astronomers of Canada are graduates of the University of Toronto, hitherto the University has possessed no observatory. This want has been recently supplied by the munificence of Mrs. D. A. Dunlap, who has presented the University with a 74-inch reflecting telescope, as well as a handsome administrative building. The inauguration ceremony took place on May 31, the chair being taken by the president of the University, Canon Cody, in the presence of the Lieutenant-Governor, Dr. Bruce, Sir Robert Falconer (a former president of the University), Mr. Mackenzie King (a former Prime Minister of the Dominion), professors of the University, and astronomers from Great Britain, Canada and the United States, and a thousand interested visitors.

After a dedicatory prayer by the Rev. E. W. Wallace, Chancellor of Victoria College, the chairman read letters of congratulation from the president of the International Astronomical Union, the president of the Royal Astronomical Society of Canada, Sir James Jeans and Sir Arthur Eddington. He then called on the architect, who handed a golden key to Mrs. Dunlap. She opened the door with the words, "In loving memory of my husband, David Alexander Dunlap, I now present this astronomical observatory to the University of Toronto, believing this memorial will express his deep interest in astronomy, and I hope through its equipment great advances will be made in the science", and handed the key to Dr. B. M. Macdonald, chairman of the Board of Governors.

After a warm expression of thanks by Dr. Macdonald, a sincere tribute to Mr. Dunlap was paid by him and by the Lieutenant-Governor. The president then called on Prof. Chant, the director of the Observatory, and noted that the inauguration had been fixed on Prof. Chant's seventieth birthday. Prof. Chant referred to Mr. Dunlap's great interest in astronomy, and said that in 1926 he ventured to lay the project of an observatory in Mr. Dunlap's memory before her. The foundation stone was laid in 1932 by Mr. Moffatt Dunlap. "To Mrs. Dunlap all the credit is due; were it not for her there would be no observatory here."

Mr. Cecil Young, manager of the firm of Sir Howard Grubb, Parsons and Co., then gave an account of

the large telescope and dome which were described and illustrated in an article in NATURE of October 14, 1933. Sir Frank Dyson gave the good wishes of the Royal Astronomical Society, and congratulated Prof. Chant on the great interest in astronomy in Canada, which was in large measure due to him. Short addresses were given by Prof. H. D. Curtis, director of the Observatory of the University of Michigan, Prof. V. Slipher, director of the Lowell Observatory at Flagstaff, Prof. H. Shapley, director of the Harvard College Observatory, and Dr. W. E. Harper, director in charge of the Dominion Observatory at Victoria.

The Observatory is situated in 160 acres of ground on Richmond Hill, some twelve miles north of Toronto, from which a beautiful view extends in all directions. It is sufficiently distant from Toronto to avoid smoke and glare, and yet near enough to the University. The number of good observing nights is estimated at about 120 in the year. The administration building is a handsome structure of stone, surmounted by three domes for smaller telescopes. It contains office and computing rooms, a library and well-equipped workshops. The large telescope is in a steel dome with the necessary insulating material to diminish changes of temperature, and was constructed by Messrs. Sir Howard Grubb, Parsons and Co. The general appearance of the telescope in relationship to the dome is very satisfactory. The clockwork and the electrical movements of the telescope and dome fulfil all requirements. The mirror of 74 inches is of pyrex, made by the Corning Company of New York. The grinding and figuring of the mirror were carried out at Newcastle, under Mr. Cyril Young's direction, by Mr. Armstrong, the very competent artist of the firm. The spectroscope was constructed by Messrs. Adam Hilger, Ltd., and is admirably adapted to determine velocities in the line of sight for which the instrument will be generally used. Telescope and spectroscope were thoroughly tested by Mr. R. K. Young. In Mr. Young, Mr. Hogg and Mr. Millman, Prof. Chant has an able, experienced and enthusiastic staff. We may look with confidence for an excellent output of work from the David Dunlap Observatory.

F. W. DYSON.

Humoral Transmission of Nervous Impulses*

IN 1921 it was proved for the first time that the modifications of the heart's function, caused by stimulation of its nerves, are due to substances liberated by the stimulation, called transmitters: acetylcholine and an adrenaline-like body respectively, which in their turn bring about the effects of stimulation. This 'humoral transmission of nervous impulses' occurs, not only in the heart, but also with stimulation of all the other vegetative nerves. Whether it also happens within the somatic nervous system is not yet settled.

The nerves releasing transmitters on stimulation

do not influence the *function* of their effective organs otherwise than by this release. But we must attribute to them an influence—independent of the release of the transmitters—on the *sensitivity* of their effector organs to peripheral, directly applied stimuli.

The discovery of the humoral transmission of nervous impulses discloses the hitherto obscure mechanism of the effect of nervous stimulation in general, and also particularly of peripheral inhibition.

As to the point of attack of nervous stimulation, that is, the localisation of the release of the transmitters, there are two possibilities: either the nerve-ending or the effective organ. There are many arguments against the latter possibility, but the former is supported by the following: (1) after nerve

* Substance of the Ferrier Lecture delivered by Prof. Otto Loewi, professor of pharmacology in the University of Graz, before the Royal Society on June 20.

degeneration, the transmitter disappears, even in cases in which the effective organ is not degenerated at all; (2) on stimulation of the preganglionic cervical sympathetic the transmitter is liberated, not within the ganglion cell, but at the synapse—in other words, from the nerve-ending. Regarding the *mechanism* of the release we have to consider also two possibilities: either the transmitter is newly formed by the nerve-stimulation, or it is made diffusible, being split off from a combination already present in the nerve-ending. The decision between these alternatives cannot yet be made.

The lapse of time between the nerve-stimulation and the response of the reacting organ is extremely short, even in organs like the heart, where the transmitter has to pass a certain distance in order to reach the effector cells. The transmitters disappear somewhat quickly, the time of disappearance being dependent on the type of action which they have to produce.

The point of attack of the transmitters is not a part of the neurone, but the functioning, effective organ itself. The fact that the transmitters, when artificially injected, mainly act at points in relation to which they are normally liberated, can be given, as yet, only a teleological interpretation. Since the transmitters can diffuse into the blood from the point

of their release, they can, in principle, also affect remote organs, though under physiological conditions this may never happen. Obviously such a distant action is unnecessary, as such needs are fulfilled by the hormones.

Finally, the question is considered whether the difference between the action of the hormones and that of the transmitters concerns only the sphere or also the character of their action. The hormones of two of the ductless glands, both being neurotropic and differing from all other ductless glands by properties common to them only—the adrenal medulla and the posterior lobe of the hypophysis—initiate or modify, according to need, the specific *function* of the organs, as the nerves or the transmitters do.

All the other ductless glands are not neurotropic; they depend largely on the anterior lobe of the hypophysis regarding their development and state; their secretion is going on continuously and automatically, though partly controlled by the nervous system. Their action is concerned less with the *specific functions* of organs than with *general conditions*—state and metabolism. In other words, there are differences not only regarding the sphere but also regarding the character of the action of the nerves and the transmitters, on one hand, and that of the hormones on the other.

Cosmic Ray Results of the American Stratosphere Balloon Explorer I

BRIEF accounts have been given in NATURE¹ of the flight of the American stratosphere balloon Explorer I and the subsequent mishap by which it was at first feared that most of the valuable photographic records had been destroyed. Subsequent expert development of the films shows that, whilst the whole of the objectives have not been

counters dividing each bank. Apart from the influence of this wall on the time resolution, the arrangement of counters in Fig. 1b would have the greater directive tendency. Two systems of recording were employed, one in which the total number of counts in a given time was integrated, and the other in which each individual count was recorded and timed. The curve of the spatial distribution of the rays at an altitude of 40,000 ft. for the two arrangements of the counters is shown in Fig. 2, in which the curve *a* corresponds to the arrangement of Fig. 1a and the

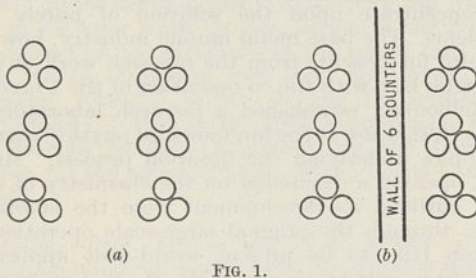


FIG. 1.

secured, those records that have been saved have yielded interesting and confirmatory results to collateral researches.

Swann and Locher have contributed an article on "The Variation of Cosmic Ray Intensity with Direction in the Stratosphere", and Millikan a short article on the results of the flight in "Stratosphere Series, No. 1" of the U.S. National Geographic Society. In the former of these researches, as many as 168 Geiger-Müller counters were employed. These were disposed as in Figs. 1a and 1b. In each case three counters close together form a unit, and corresponding ones of the nine counters on either the right or duplicate left side of Fig 1a must be influenced for a count. There were four such banks for the directions 0°, 30°, 60° and 90° to the vertical. In Fig. 1a, the counters are in the 0° position. The whole system was now duplicated as in Fig. 1b, with the addition of a wall or partition of six *neutralising*

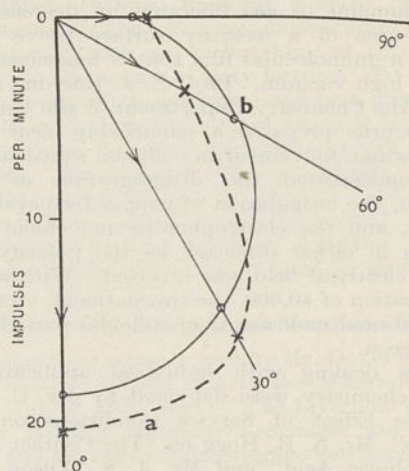


FIG. 2.

curve *b* that in Fig. 1b. The number of counts varies from about 5 per minute for rays from the horizontal direction to about 20 per minute from the vertical at this height, whilst the more recent results from a flight by J. Piccard in America give similar curves up to 53,000 ft. The dotted curve *a*, which includes

showers as well as individual rays, seems to show that the showers, on the whole, tend to come from the zenith.

When the average curve is integrated over a hemisphere and compared with a similar integration at sea-level, the ratio of the counter actions at the two heights is 64. Millikan's result with a thin-walled ionisation chamber at 40,000 ft. is $J = 250$ ions per c.c. per sec., so that if counter action is to be compared directly with volume ionisation by cosmic rays, the value of J at sea-level would be $250/64 = 3.9$ ions per c.c. per sec. As against this value for J three direct determinations are quoted, namely, Millikan 2.4, Compton 1.9, Hoffmann 1.0. Com-

parison of the mean of these three figures with 3.9 indicates that counter action does not increase at the same rate with altitude as volume ionisation in a given locality. This is generally taken to mean that there is an increasing admixture of particles in higher altitudes that will not penetrate the counters but that will penetrate the walls of the ionisation chamber.

The Neher recording shielded electroscopes were destroyed in the crash, but an unshielded one gave a record up to 60,000 ft. The result for J agrees with that of the Fordney Settle flight of November 1933.

¹ NATURE, 134, 132, July 28, 1934; 707, Nov. 3, 1934; 135, 299, Feb. 23, 1935.

Surface Chemistry and its Industrial Applications

FEW industries are not dependent, at some stage in their processes, on reactions between matter in different states of aggregation, and consequently few industrial chemists can afford to ignore the recent developments in our knowledge of the physical and chemical changes that occur at surfaces. It is not surprising, therefore, that there was a record gathering for the discussion on the theoretical aspects and industrial applications of surface chemistry arranged by Section B for the Melbourne Centenary meeting of the Australian and New Zealand Association for the Advancement of Science. Prof. J. C. Earl was sectional president.

Dr. T. Iredale, opening the discussion, reviewed recent advances in the theory of surface chemistry, and other theoretical papers were presented by Dr. J. E. Mills on "The Recombination of Atoms and Free Radicals at Surfaces" and Dr. N. S. Bayliss on "A Critical Review of the Parachor". The contention that the parachor is of little value in determining the constitution of organic compounds was supported by Dr. R. A. Robinson. Mr. R. S. Burdon discussed the influence of carbon dioxide and hydrogen on the surface tension of mercury. Measurements of the amount of gas liberated by decreasing the surface area of a mercury surface prove that it adsorbs a unimolecular film that is tenaciously held, even in high vacuum. Prof. E. J. Hartung and the staff of the Chemistry Department of the University of Melbourne prepared a remarkably clear film of the Brownian movement in colloidal solutions. This film demonstrated the disintegration of benzo-purpurin, the coagulation of copper ferrocyanide by sunlight, and the electrophoretic movement of the particles in either direction as the polarity of an applied electrical field was reversed. With a screen magnification of 40,000, the translational, vibrational and rotational movements of colloidal particles were clearly seen.

Papers dealing with industrial applications of surface chemistry were delivered by Mr. C. Blazey on "The Effect of Service Conditions on Metal Surfaces", Mr. A. R. Hogg on "The Contact Process for Sulphuric Acid" and Mr. J. S. Wilson on "A Résumé of Current Theories of the Process of Dyeing Textile Fibres". No single theory of dyeing has yet been able to explain how the various types of dye are taken up silk, cotton and wool fibres.

At a joint discussion with Section H on "Corrosion", papers were delivered by Prof. J. N. Greenwood on "The Combined Influence of Stress and Corrosion on

Metals", Prof. A. Burn on "Cavitation in Turbines and Centrifugal Pumps", Dr. G. A. Elliott on "The Passivity of Metals in relation to Corrosion", Mr. P. F. Thompson on "Modern Theories of the Corrosion of Metals", Mr. C. J. Griffiths on "Electrolytic Corrosion" and Mr. V. Wardell on "Inhibitors of the Acid Corrosion of Metals". Mr. Wardell, discussing the cleaning of iron for galvanising, enumerated a great variety of substances that, though not preventing the removal of scale by acids, greatly reduce or even prevent the dissolution of iron. Glue is commonly used for this purpose. Generally known as inhibitors, these substances are used also for cleaning boilers and water mains. The addition to hydrochloric acid of a little arsenic chloride, while preventing dissolution of the steel base of galvanised iron, does not seriously retard the solution of the zinc coating.

Most of Australia's secondary industries, being still in the early stages of development, are forced to concentrate upon the solution of purely local problems. The base metal mining industry, however, grateful for benefits from the research work of other countries has, with the co-operation of the University of Melbourne, established a research laboratory for the investigation of the fundamental physico-chemical principles underlying the flotation process. Mr. H. Hey, opening a discussion on the chemistry of flotation, outlined its development from the laboratory stage, through the original large-scale operations at Broken Hill, to its present world-wide application to a great variety of ores. Mr. A. B. Cox and Dr. Ian W. Wark then described the work of the University laboratory. The flotation of a mineral depends upon its surface being modified so that it will adhere to an air bubble. Contact angle gives a quantitative measure of the condition of the surface. The influence of the adsorption of various organic compounds known as *collectors* on the magnitude of the angle of contact, and the influence of several inorganic compounds on their adsorption, have been determined. It is concluded that a unimolecular orientated adsorption of the collector is responsible for the attachment between mineral and air bubble. There is not yet agreement as to the mechanism of adsorption.

At a luncheon given by the Australian Chemical Institute, Dr. T. Callan conveyed greetings to the chemists of Australia from the Institute of Chemistry of Great Britain and Ireland and from the Society of Chemical Industry.

University and Educational Intelligence

CAMBRIDGE.—The following appointments have been made: E. Farmer, of Trinity College, reader in industrial psychology, E. G. Chalmers, of Clare College, assistant director of research in industrial psychology, P. Graffa, of King's College, assistant director of research in economics, Dr. J. K. Roberts, of Trinity College, assistant director of research in colloid science, Dr. W. A. Wooster, of Peterhouse, lecturer in mineralogy and petrology, E. T. C. Spooner, of Clare College, lecturer in pathology, G. C. Grindley, lecturer in experimental psychology, N. Dean, of Trinity Hall, lecturer in estate management, C. Culpin, of St. John's College, demonstrator in agricultural engineering, Dr. J. D. Cockerft, of St. John's College, lecturer in physics, P. I. Dee, of Sidney Sussex College, lecturer in physics, Miss A. C. Davies, of Newnham College, lecturer in physics, Dr. M. L. E. Oliphant, of St. John's College, assistant director of research in physics, Dr. W. B. Lewis, of Gonville and Caius College, demonstrator in physics.

Prof. E. V. Appleton, Wheatstone professor of physics, King's College, London, has been appointed Scott Lecturer for the year 1936-37.

H. McCombie, of King's College, has been approved for the degree of Sc.D.

Dr. C. S. Myers has been elected to an honorary fellowship at Gonville and Caius College.

EDINBURGH.—The first Sharpey-Schafer Memorial Lecture, given on June 21 by Sir Charles Scott Sherrington, was a notable tribute paid to the late distinguished physiologist by his fellow-worker and friend. Sir Charles referred more particularly to Sir Edward Sharpey-Schafer's work in endocrinology and in neurology, and dwelt on the great interest and importance of the observations made by Schafer in 1877 on the nerve-elements in the jelly-fish *Aurelia*, and in his later work on localisation in the cerebral cortex and on the structure of the spinal cord.

Dr. C. G. Anderson has been appointed Lewis Cameron teaching fellow in the Department of Bacteriology. This is the first appointment under the scheme recently approved by the Court of Session for the administration of the Lewis Cameron Fund.

LEEDS.—Prof. Stroud has given £1,000 towards the Union building, and £100 for the Physics Museum.

Prof. J. H. Priestley has been appointed Pro-Vice-Chancellor of the University for a period of two years from July 1.

Mr. B. H. Wilsdon, director of the British Wool Research Association, has been appointed director of research students at Torridon under the scheme of co-operation between the University and the Association.

LONDON.—Dr. H. L. EASON, superintendent and senior ophthalmic surgeon of Guy's Hospital, has been elected Vice-Chancellor for the year 1935-36, and the Rev. H. B. Workman has been appointed Deputy Vice-Chancellor for the same period.

The Right Hon. Lord Hanworth, the Master of the Rolls, has been appointed Creighton Lecturer for the year 1935-36. The lecture, entitled "The Preservation of our Archives, National and Local", will be delivered at the London School of Economics during the Michaelmas term.

OXFORD.—The Johnson Memorial Prize for 1935 has been awarded to Dr. T. G. Cowling, Brasenose College, at present lecturer in mathematics at the University College of Swansea. The prize consists of a gold medal of the value of ten guineas, together with a sum of money. It is awarded once every four years for an essay on some astronomical or meteorological subject. It is understood that Dr. Cowling's essay was entitled "Convection in Stars".

ST. ANDREWS.—At a meeting of the University Court held on Saturday, June 22, the following appointments to vacant chairs in University College, Dundee, were made:—*Mathematics*: Dr. E. T. Copson, Royal Naval College, Greenwich; *Physiology*: Dr. Robert C. Garry, Rowett Research Institute, Bucksburn, Aberdeen.

PROF. J. GRAHAM KERR, F.R.S., regius professor of zoology in the University of Glasgow, has been elected M.P. for the Scottish Universities. The by-election was caused by the appointment of Lord Tweedsmuir (formerly Mr. John Buchan) as Governor-General of Canada. The voting was: Prof. J. Graham Kerr (Nat. Govt.), 20,507; Mrs. N. Mitchison (Lab.), 4,293. As remarked in a note referring to Prof. Graham Kerr's candidature in NATURE of June 1, p. 919, his election involves giving up the life tenure of his professorial chair.

Science News a Century Ago

Middlesex Hospital Medical School

Sir Charles Bell (1774-1842), the surgeon, writing to his brother George Joseph Bell (1770-1843), the lawyer, on June 29, 1835, said:

"My dear Brother,

"We have founded a school in the garden of the Middlesex Hospital. The building will be a complete little thing—theatre, museum, clinical class-room and dissecting room. But you must admire my spirit to commence such an undertaking at this day. I promise to the extent of sixty lectures. To the work I have no objection, but there will be a great outlay also, although from the way in which it is taken by the governors, I believe subscriptions will cover all expenses. The building will cost £2,400."

Writing again on July 22, he said: "Would you believe that our school is already roofed? It seems like magic. We pay for that, however. But for dispatch we might have had it built for much less."

Locomotives on the Liverpool and Manchester Railway

Quoting from a paper read by Mr. David Stevenson to the Scottish Society of Arts, the *Mechanics' Magazine* of July 4, 1835, said: "The Liverpool and Manchester Railway locomotive-carriages are of three kinds, and are called train, luggage and bank engines. The train-engines average about 30 horses' power; they weigh about 8 tons, and cost about £900. The luggage-engines are in general, 35 horses' power, and weigh about 9 tons; they cost about £1,000. There are only two bank-engines, the *Goliath* and *Samson*, which are used for assisting the trains up the inclined planes at Whiston and Sutton; they are about 50 horses' power, weigh about 12 tons and cost

about £1,100. The Company has had altogether 32 locomotive-carriages made. . . The *Vulcan*, a train engine, ran no less than 47,000 miles before it required to be repaired; and the *Firefly* ran 50,000 miles. The greatest speed which the engines have been able to obtain on a level is 60 miles per hour, without a load."

Death of Sir Edward Banks, 1770-1835

On July 5, 1835, Sir Edward Banks died at Tilgate Lodge, Sussex, and a few days later was buried at Chipstead, Surrey, where both his tomb and monument are to be seen. Born near Richmond, Yorkshire, on January 4, 1770, in a humble station of life, Banks raised himself to the highest position among civil engineering contractors, and "during 40 years was engaged on the erection of some of the most useful, extensive and splendid works of his time". His earliest experience was gained in canal construction in the north of England, partly under John Rennie and William Jessop. Probably through the latter he became connected with the Surrey Iron Railway from Wandsworth to Merstham, and was thus brought into contact with the land-owning family of Jolliffe at Merstham. In 1807 he entered into partnership with the Rev. William John Jolliffe (1774-1835), who abandoned the Church for engineering, and the partners were soon engaged on a succession of important works, which included the Waterloo, Southwark, London and Staines Bridges over the River Thames. They also carried out contracts in connexion with the ports of Howth and Goole, Deptford and Sheerness Dockyards, and with the improvement of the Rivers Nene, Witham and Ouse. The bridge over the Serpentine, Hyde Park, was built by them in 1824. On June 12, 1822, Banks was knighted for "the extraordinary exertions, industry, skill and perseverance he had displayed in the execution of the Waterloo and Southwark Bridges", this being the first instance of this honour being bestowed on a professional engineer.

Alphonse De Candolle's Treatise on Botany

Among the natural history works of lasting interest published in 1835 was the "Introduction à l'étude de la Botanique ou Traité Élémentaire de cette Science" of Alphonse De Candolle, professor at the Academy of Geneva. A review of this work appeared in the July issue of the *Records of General Science*. "This work," said the review, "may therefore be considered the most complete treatise which has appeared on the subject, and it is written with great precision and clearness. It exhibits a great extent of botanical knowledge, and is accommodated to the present state of the science, as the author states the opinions brought forward in the most recent European works of botany, and candidly adopts those which appear to him of most weight. . . . The most curious and novel part of the work is that which relates to botanical geography. The most imperfect part of the work is that which treats of the superior phenomena, which escape our physical explications, and which depend on unknown powers, which we are in the habit of designating by the obscure name of vital powers, because they are connected with the preservation and permanence of the species. . . . The explanation of all these phenomena, and many others, will, however attract the attention of botanists, and sooner or later, we may expect them to be elucidated."

Societies and Academies

DUBLIN

Royal Dublin Society, May 28. W. J. LOOBY and J. DOYLE: Fertilisation and pro-embryo formation in *Sequoia*. Fertilisation takes place in Irish material of *Sequoia gigantea* in August of the first year, being rapidly followed by pro-embryo and early embryo development. The embryo is not completed until the second year, the winter being passed in the embryo-with-suspensor stages. The pro-embryo only occupies the lower part of the archegonium, with wall formation at the eight-nuclei stage, the complete pro-embryo showing a 2-6-6 or a 3-5-5 arrangement. *Sequoia sempervirens*, though forming a wall at the first division of the fusion nucleus as already recorded, leaves unused protoplasm at the top of the archegonium, the pro-embryo frequently occupying only one half of it. E. J. SHEEHY: Note on the effect of storage on the colour and on the free fatty acid content of a commercial sample of veterinary cod liver oil. Slight hydrolytic and very considerable oxidative changes occurred in veterinary cod liver oil stored under different conditions. Colour changes associated with increased free fatty acid content, and induced by contact with the material of the container, occurred. REPORT OF THE IRISH RADIUM COMMITTEE FOR THE YEAR 1934: This includes reports submitted by medical users of radon supplied by the Committee, and records the treatment of 441 malignant and 149 non-malignant cases. This is a considerable increase over the total number (466) recorded in the 1933 report. A tendency towards the use of smaller doses has, however, reduced the total quantity of radon issued from 12,996 mC. in 1933 to 11,744 mC. in 1934.

EDINBURGH

Royal Society, June 3. T. NICOL: Studies on the female reproductive system in the guinea pig: intravital staining; fat production; influence of hormones. Special cells showing maximum amount of trypan blue occur in the endometrium only in large numbers at certain stages of the sexual cycle, and are practically absent in sexually immature animals. This condition, absent in ovariectomised animals, was produced by oestrin injections, but not by administration of corpus luteum hormone or anterior pituitary. The fat deposit also appeared cyclic, and was produced artificially in ovariectomised animals by injection of corpus luteum extract, after sensitisation with oestrin. In the pregnant animal, around the embryo, cells, proved endometrial by development, absorb the dye and form embryotrophe. The results as a whole indicate that the function of cells absorbing the dye is histiotrophic. G. BOND: The endodermis in light-grown and etiolated shoots of the Leguminosæ: a contribution to the causal study of differentiation in the plant. Priestley's observations on the promoting effect of etiolation upon differentiation of primary endodermis in the shoots of various members of the Leguminosæ have been confirmed and extended in the present work. Light appears to be the particular environmental factor responsible for the non-development of the endodermis in these shoots under normal growth conditions. In other leguminous plants, the effect of etiolation was less marked. The development

under normal conditions of the basal endodermis in *Vicia Faba*, etc., does not appear to be entirely due to the differentiation of the first internodes in darkness occasioned by the soil or by the presence of the cotyledons. The initial development of these internodes in the darkness of the ovary may also be responsible. R. A. ROBB and T. R. TANNAHILL: Lunar atmospheric inequality at Glasgow. An analysis of the Glasgow Observatory hourly barograph records, 1868-1912, rearranged according to lunar time, shows that there are significant diurnal and semi-diurnal variations of pressure; for the 4,290 days considered, during which the daily range of pressure did not exceed 0.1 in. of mercury, the variations can be represented by $0.0640 \sin(\theta - 267^\circ)$ millibar, and $0.0156 \sin(2\theta - 285^\circ)$ millibar. The data were also subdivided in various ways as in Prof. Chapman's investigation of a similar nature. All subdivisions show characteristics similar to those for the total data as given above.

PARIS

Academy of Sciences, May 13 (*C.R.*, 200, 1641-1696). ALFRED LACROIX: Stony meteorites fallen in Air (Niger Colony). The examination of meteorites found 95 kilometres apart indicates that these had a common origin. EMILE MATHIAS: The diameter of the curve of densities. EUGÈNE BLANC: The idea of distance. PAUL ALEXANDROFF: Discrete spaces. GEORGES GIRAUD: Certain operations of the elliptic type. G. MIHOC: The determination of the contraction interval of the formula of the mean. BERNARD KWAL: Some remarks on the electrodynamics of Born and Infeld. JEAN VILLEY: The classification of the energy losses according to the rôle of the irreversible operations. B. ROSEN and M. DÉSIKANT: The emission spectrum of the molecule CSe. JEAN TIMMERMANS and LOUIS DEFFET: Experimental researches on the physical constants of heavy water. The variation of the melting point as a function of the pressure. The fusion curve of heavy water is practically parallel to that of water, although its inclination is slightly less. No evidence has been found of the existence of polymorphic forms. ROBERT TRÉHIN and BORIS VODAR: The absorption spectrum of liquid hydrogen chloride in the extreme ultraviolet. HENRI TRICHÉ: The quantitative spectrum analysis of calcium and barium in light alloys and in solutions, and various influences on the emission of the lines. ADRIEN KARL: Zirconium pyrophosphate. Study of the properties of zirconium pyrophosphate from the point of view of separating zirconium from iron and titanium. M. BACKÈS: The constitution of the aldols. PAUL GOLDFINGER and WLADIMIR LASAREFF: The reaction of the amines with heavy water. The results tend to prove the accuracy of the ordinary formula for the amines as opposed to that suggested by J. Thomsen. CHARLES DUFRAISSE and MAURICE LOURY: Research on the dissociable organic oxides. 1,1-Diphenylrubene, $C_{30}H_{20}$: the thermal decomposition of its photoxide, $C_{30}H_{20}O_2$. This diphenylrubene is the first of the photoxides of this group which is not dissociable; on heating, it forms a red resin without evolution of oxygen. MARCEL ROMET: The synthesis of the quinoline bases starting with oxymethylene derivatives of ketones. JEAN LOMBARD: Conclusions of a lithological study of the crystalline schists of central Oubangui-Chari. ARTHUR STOLL and ERNEST BURCKHARDT: Ergobasine, a new alkaloid from ergot

of rye, soluble in water. This alkaloid has the formula $C_{19}H_{23}O_2N_3$ and on account of its solubility in water and slight solubility in chloroform can be easily purified. RENÉ MARTIAL: The cephalo-hæmatic parallelism and its consequences from the point of view of race. ALPHONSE LABBÉ: A new function of the coupling organ of the Silicoderms. ROBERT WEILL: The division of anucleated and highly differentiated cellular elements: the multiplication, by fission, of the colloblasts of *Lampetia pancerina*. JULES AMAR: The regeneration of the nails. CAMILLE CHARAUX and JACQUES RABATÉ: Persicoside. A glycoside isolated from the bark of the peach tree, the β -glycoside of hesperetol, $C_{22}H_{24}O_{11}$. AUGUSTE and RENÉ SARTORY, JACQUES MEYER and FRÉDÉRIC ARNOLD: Preliminary study in defined synthetic media of the cultural factors necessary for determining the fertility of the soil by means of *Sterigmato-cystis nigra*. CONSTANTIN LEVADITI and ARON VAISMAN: The curative and preventive action of 4'-sulphamido-2,4-diaminoazobenzene in experimental streptococcal infection.

AMSTERDAM

Royal Academy (*Proc.*, 38, No. 5, April 27, 1935). H. R. KRUYT: Action of electrolytes on hydrophobic colloids. To explain the action of electrolytes on a sol it is necessary to distinguish between those ions which are potential-determinative and those which are not. J. LE HEUX and A. DE KLEYN: Reaction of the eye muscles to two simultaneously applied stimuli, together with a contribution to the question of the labyrinthine genesis of miner's nystagmus. A. PANNEKOEK and S. VERWEY: The Stark effect of hydrogen in early type stellar spectra. The profiles of the hydrogen lines depend largely on the surface gravity and allow of a certain identification of white dwarf stars. W. H. KEESOM and MISS A. P. KEESOM: New measurements on the specific heat of liquid helium. New measurements at 19 and 25 atmospheres pressure. W. H. KEESOM and C. W. CLARK: The atomic heat of nickel between 1.1 and 19.0° K. There is a large heat capacity above that calculated from Debye's law which is given by $C = 0.001744 T$. L. S. ORNSTEIN: Mean values of the electric force in a random distribution of charges. A. A. NYLAND: Mean light-curves of long-period variables (23). X Aurigæ. The light of this star varies with a period of 163 days and an amplitude of 4.21 magnitudes. F. M. JAEGER, R. FONTEYNE and E. ROSENBOHM: The exact measurement of the specific heats of solid substances at higher temperatures (18). On the use of Dewar vacuum vessels for the control of the cooling rate. T. J. POPPEMA and F. M. JAEGER: The exact measurement of the specific heats of solid substances at higher temperatures (19). The specific heats of zinc, magnesium and their binary alloy MgZn₂. The molecular heat of MgZn₂ is less than that calculated by assuming the atomic heats of the constituents are additive. W. HUREWICZ: Contributions to the topology of deformations (2). Homotopy and homology groups. C. S. MEYER: Some further integral representations of the Whittaker function. P. E. VERKADE, J. VAN DER LEE and K. HOLWERDA: Researches on fat metabolism (6). Experiments with α -lauro- β -diundecylin. In the alimentary tract the two fatty acids are liberated at the same rate from α -lauro- β -diundecylin and from the corresponding mixture of trilaurin and triundecylin. W. J. ROBERTS: A new procedure for the detection of gold in animal

tissues: physical development. Detection of gold in animal tissues by physical development in a solution of gum arabic, silver nitrate, hydroquinone and citric acid. MISS M. A. KENNARD: Clinical and histological observations on a case of primary cortical degeneration of the cerebellum. A case of progressive ataxia showed complete degeneration of the Purkinje cells of the cerebellum. A. DE BUCK and N. H. SWELLENGREBEL: Further studies on and discussion of the results of cross-mating the races (varieties) of *Anopheles maculipennis*. Crossing experiments with *Anopheles* from Sweden and Holland showed that the varieties were identical in the two countries. H. J. MACGILLAVRY: Remarks on Rudists.

SYDNEY

Royal Society of New South Wales, May 1. R. J. NOBLE: Some aspects of problems associated with the preservation of health in plants (presidential address). Reference was made to early records of the occurrence of plant diseases in New South Wales and to the urgent need for more general adoption of established measures of control in order that there might be greater stability in agricultural production. The conditions of health and disease are not always readily differentiated. Submerged infections, delayed development of symptoms and virus-masking are phenomena of academic interest and practical importance. Variability and plasticity of host and pathogen and the significance of factors in the environmental complex were discussed. Synergic and antibiotic phenomena are being more widely recognised in local problems. Climatological factors were reviewed in relation to plant quarantine and spray forecasting services. Virus diseases were discussed in relation to plant responses, and the question was raised as to whether any groups of symptoms are comparable physiologically with those resulting from other causes.

ROME

Royal National Academy of the Lincei, March 17. T. BOGGIO: Integration of Helmholtz's hydrodynamic equations. A direct integration of these equations, to obtain Cauchy's integrals, is given. F. TRICOMI: The inversion of Laplace's transformation. B. MANIÀ: Conditioned problems of the calculus of variations. R. L. GOMES: The deduction of Lorentz's formulae. D. GRAFFI: The effect of a variation in mass on a planetary orbit. R. L. GOMES: Considerations on the fundamental equation of Louis de Broglie's "New Conception of Light". L. SOBRERO: Functions analogous to potential in mathematical physics. G. R. LEVI and D. GHIRON: Action of arsenic acid and arsenates on hydrogen peroxide. In small proportions, arsenic acid has a stabilising action on hydrogen peroxide, but at higher concentrations the ion AsO_4''' exhibits a specific decomposing effect. L. MUSAJO: Investigations on xanthurenic acid (2). The results of experiments in which various animals were fed with fibrin show that, with the albino rat or rabbit, xanthurenic acid, quinurenic acid and quinurenin are eliminated in the urine, and with the dog, quinurenic acid and quinurenin, without xanthurenic acid. L. MUSAJO and F. M. CHIANCONE: Investigations on xanthurenic acid (3); genesis of the acid. In the rat, xanthurenic acid is formed from tryptophane, probably with intermediate formation of quinurenin.

Forthcoming Events

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

Sunday, June 30

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Miss M. R. J. Edwards: "Protective Colouring and Mimicry".*

MUSEUMS ASSOCIATION, July 1-4. Forty-sixth Annual Conference to be held in Brussels.

SOCIETY OF CHEMICAL INDUSTRY, July 1-6. Fifty-fourth annual meeting to be held in Glasgow.

July 2 at 10.45.—Edwin Thompson: "National Water Supplies."

At 3.—Commander J. L. Bedale: "Some Problems in Chemical Engineering which arise in H.M. Navy."

July 3, at 9.30: Sir Harold Hartley and Dr. A. J. M. Smith: "How Food is Transported by Rail and Sea".

July 4, at 10.—Dr. E. F. Armstrong: "The Past, the Present and the Future" (also presentation of the Medal of the Society to Dr. Armstrong).

UNIVERSITY OF BRISTOL, July 2-5. Conference on "Some Aspects of the Metallic State", to be held in the H. H. Wills Physical Laboratory.

Official Publications Received

GREAT BRITAIN AND IRELAND

The British Science Guild: Engineers' Study Group on Economics. First Interim Report on Schemes and Proposals for Economic and Social Reforms. Pp. 44. 1s. The Annual Report of the Council of Management 1934-1935, presented at the Annual General Meeting held at the Royal Society of Arts, London, on Wednesday, 12th June 1935. Pp. 23. 1s. (London: British Science Guild.)

Home Office. Reports of the Poisons Board in regard to the Poisons List and Draft Poisons Rules prepared in accordance with the Pharmacy and Poisons Act, 1933. (Cmd. 4912.) Pp. iv+62. (London: H.M. Stationery Office.) 1s. net.

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 14: The Anatomy of the Adhesive Apparatus in the Tadpoles of *Rana afghana* Günther, with Special Reference to the Adaptive Modifications. By Jnanendra Lal Bhaburi. Pp. 339-349+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 1s. 9d.

OTHER COUNTRIES

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation. Progress Report (No. 4) for the Year 1934. Pp. 16+3 plates. (Zomba: Government Printer.) 2s. 6d.

Report for the Year 1934 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 13. (Cape of Good Hope: Royal Observatory.)

Memoirs of the Asiatic Society of Bengal. Vol. 9, No. 7: Geographic and Oceanographic Research in Indian Waters. Part 7: The Topography and Bottom Deposits of the Laccadive Sea. By Lieut.-Col. R. B. Seymour Sewell. Pp. ii+425-460+plates 9-10. (Calcutta: Asiatic Society of Bengal.) 2.13 rupees.

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Fiskeri, Bind 10, Nr. 1: Cod Marking Experiments in the Waters of Greenland. By Paul M. Hansen, Ad. S. Jensen and A. Vedel Tåning. Pp. 119. (København: C. A. Reitzels Forlag.) 3.00 kr.

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1934. By A. H. Malpas. Pp. F26. (Colombo: Government Record Office.) 25 cents.

Whether Public Relations Work? An Examination of the Development and Sociologic Aspects of Public Relations Technics. By William A. Hamor. Pp. 24. (Pittsburg, Pa.: Mellon Institute of Industrial Research.)

Summary Proceedings of the Twenty-ninth Meeting of the Indian Central Cotton Committee, Bombay, held on the 28th and 29th August 1934. Pp. 129. (Bombay: Indian Central Cotton Committee.)

The Indian Forest Records. Vol. 20, Part 16: A Stand Table for Sal (*Shorea robusta*) evenaged High Forest and Coppice. Pp. 18. (Delhi: Manager of Publications.) 12 annas; 1s. 3d.

CATALOGUES

Botany, Gardens and Gardening, Agriculture and Herbs. (Catalogue No. 588.) Pp. 36. (London: Francis Edwards, Ltd.)

B. D. H. Chlorotex Outfit: for Determination of Free Chlorine in Drinking Water and Swimming Pools. Pp. 12. (London: The British Drug Houses, Ltd.)

Cambridge Thermo-Electric Pyrometers for Temperatures up to 1400°C. Pp. 6. (London: Cambridge Instrument Co., Ltd.)
Temperature Humidity and Pressure Controller. (List No. R.S. Pp. 64. (London: Negretti and Zambra.)

