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CONTENTS.

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Prevention of Atmospheric Pollution.

FROM time to time abnormal visitations like the heavy fog in the valley of the Belgian Meuse, Dec. 3–5, 1930, resulting in sixty-five deaths, emphasise the dangers of atmospheric pollution. Although John Evelyn, writing in 1661 in "Fumifugium"—the first smoke abatement pamphlet—clearly portrayed the noxious effects of an impure atmosphere, efforts at smoke abatement have not progressed at anything approximating to the rate at which sources of contamination have multiplied during the last two centuries.

In the Meuse fog tragedy, the evidence indicates that the poisonous fumes from industrial chimneys which became imprisoned in the fog were mainly responsible for the casualties. Similarly, Dr. Turner attributes the fog catastrophe in the industrial region south of Luttich to the presence in the atmosphere of fluorine compounds—hydrogen fluoride, silicon fluoride, or possibly silicofluorohydrins—from some industrial process.

It is only under abnormal atmospheric conditions when the scavenging of the air by turbulence is reduced that the menace to health which the emission of poisonous industrial fumes represents is clearly demonstrated. The aggregate number of annual deaths of both young and old which can be definitely attributed to the filthy atmosphere in our smoke-ridden towns is very much greater than those associated with such exceptional conditions. The increase in mortality rates from pneumonia, bronchitis, and other respiratory diseases associated with every spell of foggy weather, and the acceleration of invalidism and death owing to the acid condition of the atmosphere and the exclusion of direct sunlight, pass almost unnoticed, although John Evelyn's comment is as pertinent now as in Restoration times: "The consequences then of all is, that . . . almost one half of them that perish in London dye of phthisical and pulmonic distempers: that the inhabitants are never free from coughs and importunate rheumatisms, spitting of impostumated and corrupt matter: for remedy whereof, there is none so infallible, as that, in time, the patient change his Aer, and remove into the country".

Litigation concerning the Barton power station near Manchester has directed attention to the dangers of the emission of fumes as distinct from smoke. The remarks of the judges in this case appear to have had salutary effect and roused authorities in time to the importance of the new power stations consuming their own smoke. Not

only has an eminent architect, Sir Gilbert Scott, been consulted on the design of the huge producing plant at the new Battersea station, but as a result of scientific research new methods of treatment of the fumes have been devised by Dr. G. L. Pearce and his assistants, which ensure the ready conversion of the sulphur dioxide into sulphuric acid or other products which are easily removed. The Minister of Transport has stated that as a result of the precautions, on which the Electricity Commissioners have insisted, only a negligible amount of sulphur will be emitted.

The problem of reducing or preventing the emission of smoke from factories is relatively simple, being mainly economic. Corrosion of plant and buildings and the heavy expense of cleaning and maintenance, which are the direct result of the deposition of a corrosive mixture of soot, tar, mineral ash, and sulphurous acid from the atmosphere, are rapidly impressing on industry the economic advantage of eliminating the pollution at its source. The realisation that smoke is largely the result of inefficient combustion has led to a widespread application of the principles of fuel technology in industry, which have already materially reduced the proportion of industrial smoke, and for many industrial purposes coke and other forms of smokeless fuel are largely used in place of raw coal.

The progress made in smoke abatement in regard to industry, and the fact that the most dangerous atmospheric impurities are derived from industrial sources, tend to obscure the importance of the domestic factor. By far the greater proportion of atmospheric pollution as smoke comes from the domestic sources in consequence of our preference for the open coal fire. In London and Glasgow, domestic fires, for example, account for 75 per cent of the deposited solid matter. Unfortunately, the minimising of smoke emission from such sources is a much more difficult problem, and scarcely capable of legislative control.

As the latest report of the Standing Conference of Co-operating Bodies for the Investigation of Atmospheric Pollution under the scheme organised by the Department of Scientific and Industrial Research indicates, however, owing to the importance of the domestic factor, further progress in the improvement of atmospheric conditions in many of our large towns is largely conditioned by the extent to which gas, electricity, or smokeless fuel replaces raw coal for heating in the house. Much more might be done in this field, particularly in regard to local housing schemes. The importance of the domestic factor renders it highly desirable that 'garden suburbs' and similar schemes should not involve a continuous extension of the radius of serious atmospheric pollution. Houses in such schemes might be wholly or mainly equipped for heating by methods other than that of burning raw coal.

The prevention and control of atmospheric pollution in its range and complexity is characteristic of those modern problems which require the leadership of science for their solution. The production of a satisfactory smokeless fuel is still in an experimental stage, although such fuels as coalite have already met with a certain amount of public approval. The production of these fuels at a popular price has yet to be achieved, and its possibility is openly challenged in some quarters. It will at best in part be determined by the value and successful exploitation of the by-products of the low temperature carbonisation process, especially the tar oils. The successful utilisation of the large quantities of such tars which would be available if the low temperature carbonisation fuels absorb any considerable proportion of the domestic market is a major industrial and scientific problem. Equally complex is the reaction on the coal industry of a large demand for the grades of coal used for such carbonisation processes, and a concurrent reduction in the demand for high grade house coal.

The whole problem is intricate and in every aspect demands the application of scientific methods, if the necessary elasticity and balance are to be obtained. In few fields could premature legislation have a more mischievous effect. Since April 1927 the Department of Scientific and Industrial Research has been responsible for co-ordinating observations of atmospheric pollution all over the country, and for the prosecution of research into the nature of this pollution, and of the best methods for measuring it. An Atmospheric Pollution Research Committee has undertaken a fairly extensive programme of research, and investigations on the lateral distribution of atmospheric pollution which are being carried out at Norwich have attracted particular attention.

There are indeed only three places in England and Wales with populations above one quarter of a million which do not appear on the list of co-operating bodies undertaking the investigation of atmospheric pollution. These are Bristol, Nottingham, and West Ham. The absence of Nottingham from the list gives pertinence to the record in the annals of Dunstable (quoted by Shaw and Owens in "The Smoke Problem of Great

Cities ") that, in the year 1257, Eleanor, Queen of Henry III., was obliged to leave the town of Nottingham, where she had been sent to stay during the King's absence in Wales, and removed to Tutbury Castle instead, owing to the smoke of the sea coals.

Apart from direct research on atmospheric pollution, scientific workers are making important contributions, as already indicated, in fuel technology and research, including methods for the precipitation and combustion of smoke particles as emitted, the design of new industrial plant, and the control of industrial processes. The efficient application of the results of research in this field largely depends on them. Suggestions for the improvement of industrial processes, especially the elimination of noxious vapours, are mainly due to their observations and investigations. Their participation in the educational campaign that is required should assist the removal of prejudices and correct the extravagant statements which are frequently made on behalf of new products. Observations made in their private capacity when adopting the smokeless methods of heating will materially assist in the improvement of the quality of the smokeless fuels or types of electric or gas fires in use. Progress in domestic heating can be greatly accelerated by scientific co-operation along such lines, and if such co-operation were more widely established a salutary check would be available on the activities of those who, by offering inferior smokeless fuel to the public, are prejudicing its sale. From every angle the prevention of atmospheric pollution is one that demands the support of all scientific workers, and not the least important contribution they can make is that of example.

Electric Pendulum Clocks.

Electric Clocks. By F. Hope-Jones. Pp. xv + 261. (London : N.A.G. Press, Ltd., n.d.) 12*s.* 6*d.* net.

THE fact that there is a foreword by the Astronomer Royal is the best evidence that this is a serious work. The Astronomer Royal indicates that it is characteristic of the author in manner and style, as I shall have occasion to do in this notice. I have at once discarded the customary third person and have begun in the first. When dealing with the later portion of the book, which relates to matters which I have followed so closely throughout their progress, any attempt to discuss the matter and express my own views and those of others would lead to too great a complication, if the conventional third person were to be used.

Let me at once say that the author writes as the 'high priest' who knows that his religion is the only true religion and his faith the only true faith : from one end of the book to the other he preaches the one doctrine as to the way to follow to attain the perfect clock ; all other ways are vain, and lead, if not to perdition, to less perfect results. Like St. Athanasius, his faith is clear and emphatic, and the conclusion of 'St. Hope-Jones' is like that of his predecessor and in almost the same words, " This is the clock faith : which except a man keep faithfully he cannot be safe ". There is, however, this difference, that whereas the faith of St. A. requires much practice before it can be believed properly, that of 'St. H.-J.' appeals directly to reason and is quite easy to believe the first time. In fact, with thed amnation clause somewhat tempered, I am prepared to subscribe to it myself.

The title appears to me slightly misleading. An electric clock which vies in accuracy with the most perfect clock known, to which the whole book leads up, is not even mentioned. This is the quartz crystal clock perfected by Mr. W. A. Marrison, of the Bell Telephone Company's research laboratory, without which the real perfection of the champion clock would not and could never be known. A correct title would be " Electric Pendulum Clocks ", that is, clocks depending on gravity, as distinct from electric clocks with balance wheel control, which, if they exist, are quite unimportant, and from the quartz crystal clock which depends on the electro-mechanical properties of the crystal and is independent of gravity. It is this final comparative check on the going of *the* champion clock (Shortt) described in March last by Prof. E. W. Brown and Mr. Dirk Brouwer at the Royal Astronomical Society, of which publication has only recently taken place, that has shown the high-water mark of performance which has been reached. Mr. Hope-Jones may well be proud of the very important share that he has had in the development of an electric pendulum clock of unapproached perfection.

Mr. Hope-Jones traces the history of electric clocks from the earliest by Wheatstone and Bain, and his account is the more valuable because not only has he the whole history at his finger-ends, but also he brings to bear his very complete understanding of the conditions of success, which have made the synchronome and the Shortt clocks what they are, to examine critically the designs of earlier clocks. The peculiarity of the electric clock is that as soon as a student or a mechanic has learned

about an electric circuit, an electromagnet, and a contact, he straightway invents an electric clock. As we are told, he is probably entirely ignorant of what has been done, of what is wanted, and of the precautions necessary if all the pitfalls are to be avoided. Proposals for electric clocks are as the sand on the seashore. A minute fraction of these have ever seen the light, but these still are legion. Those who remember the electric experiments that we used to make fifty to sixty years ago will realise at once one of the many causes of failure. The lightest contact of a platinum wire backed by the 'current of one Daniel cell' was found to respond, but except for the purpose of a temporary experiment, it would inevitably fail if it were depended on for continued service. Eighty-six thousand four hundred of such contacts every day, day by day and year after year, were impossible and useless, and it is very difficult for those conducting electrical experiments in these days with new materials and lots of volts to visualise the early conditions. Take, for example, the success of the Strowger system (to mention only one) for automatic telephones, where every call requires the faithful response of a very large number of contacts; such would have been impossible with the delicate means available for early inventors.

One of the points insisted upon by the author, not once but all the time, is that an electric contact in an electric clock must be almost of a violent kind; it must at least be very firm, to be any good, and he gets this by using the contact as the operative pressure point, so that hesitation is impossible. The light and hesitating contact invariably fails. It was no doubt the experience of repeated failure in one electric clock after another that led Lord Grimthorpe to his adverse opinion. Those who knew him will remember that he, too, had very definite views on clocks and bells and architects and things, and that he never seemed shy of expressing himself very definitely. Mr. Hope-Jones quotes these passages from his well-known book, "Clocks, Watches and Bells": "These clocks never answered in any practical sense, nor would anything but the strongest evidence, independent of the inventor, convince me that any independent pendulum directly maintained by electricity can succeed in keeping good time for any considerable period. . . . And anyone who sets to work to invent electrical clocks must start with this axiom, that every now and then the electricity will fail to lift anything, however small."

Well, this was a proper and natural conclusion at the time, and when Lord Grimthorpe showed me his gravity escapement regulator in the late 'seventies, that was, in his opinion, the last word in clock design. Jumping, then, the whole history of electric clocks in the interval, it is interesting to find the electric clock on a pinnacle of perfection such as we now see.

It would be tedious, even were space available, to refer chapter by chapter to the author's account of all the clocks discussed. It will be more useful to pick out a few examples which have an interest of their own or which mark steps on the road to the Shortt clock.

One of the early attempts to make a high precision clock was that by Sir David Gill at the beginning of the present century. He aimed at a free pendulum maintained at a uniform temperature and low pressure. The free pendulum was nursed by a slave pendulum of rather less period, which was released by an electric contact following the impulse on the free pendulum and then caught and held until it was released again. Sir David showed me the clock in its place at the Cape Observatory and spent a long time going into the details. I did not like the idea of the slave pendulum being arrested every two seconds and then starting again. Any slave clock should be a complete going clock, but it was difficult to criticise an instrument so dear to the heart of that delightful man. I felt that there were so many things to see to, that it would be a full-time occupation for an attendant to keep it in order.

The first slave pendulum clock which was a complete clock that I ever saw was that shown by Mr. C. O. Bartrum at a meeting of the Physical Society in or about 1914. Here the free pendulum sent a synchronising message to the slave every minute instead of every two seconds, while on the other hand the slave with a somewhat clumsy lost-time device sent an impulse message to liberate an impulse lever to keep the free pendulum going. Mr. Bartrum's ideas were good but his technique was poor, and this is severely criticised by the author.

We learn from Mr. Hope-Jones that the first free pendulum was one described by R. J. Rudd in the *Horological Journal*, 1898, 1899, but important as his contribution was, he did nothing with it. However, it is interesting to know that Mr. Hope-Jones acquired Rudd's clock and presented it to the Science Museum at South Kensington.

Early in the present century, Sir Henry Cunynghame made a number of experimental clocks. His aim was, as Airy's had been long before, to maintain the oscillations of a seconds pendulum

by means of a chronometer escapement acting on the pendulum at the middle only of its swing. The escapement was placed at the lower end of the pendulum, a position advantageous for operation but decidedly inconvenient. Mr. Hope-Jones and Sir H. Cunynghame collaborated, and the outcome of this was a sort of combination of a most important prior invention of Mr. Hope-Jones, which he had described in 1895, and some of the features of Sir H. Cunynghame's clock. The important invention referred to was the use of the electrical contact to transmit mechanically a strong impulse, thus ensuring unfailing action. Further progress found the impulse operation removed from the lower end of the pendulum to a point near the upper end. Another important feature was the introduction of a count wheel which allowed an impulse to be applied every thirty seconds only, and the synchronome clock as we have known it for so long as a most successful instrument came into being. In this the Hope-Jones articles of faith are all to be found with another of his really beautiful mechanical devices, the form of ratchet drive by which all the dials operated by the master clock make their half-minute jumps without the possibility of overshooting or failing. They are not silent, and an irritable listener in a bedroom might want to throw a boot at the dial.

The synchronome system has been so great a success that the author may well congratulate himself that he was not discouraged by Lord Grimthorpe but went his own way. He may also congratulate himself in that it is the synchronome clock on which Mr. Shortt has grafted his invention. Mr. Shortt has a free pendulum in a nearly vacuous case—which should be deep underground but never is—subject to an impulse every half minute. The impulse lever is liberated by a slave clock which is a synchronome master clock, and the impulse lever, after acting on the free pendulum, drops and makes a firm contact which resets the impulse lever through the intervention of an inertia piece, and it also sends a current to the hit-and-miss device which keeps the synchronome pendulum in exact step. This latter device is most fascinating to watch, and people are apt to think that that is all that Mr. Shortt has done. The author shows what a long series of devices Mr. Shortt experimented with before he got his inertia delay action to ensure good contact and the right phase. Not the least important feature in the Shortt clock is the unfailing accuracy of response of the half-minute time signals to the position of the free pendulum. A mere contact operated by a slow-moving wheel would be quite useless except for rating over long periods. The lever actually dropped after its impulse on the free pendulum indicates the time correctly to a thousandth of a second at least, as proved by the operation of the Loomis spark chronograph, and if the hundred and twenty records in an hour are taken the time is known to the ten-thousandth.

The marvellous improvement in timekeeping effected by the Shortt clock was first recognised by the Astronomer Royal for Scotland. Shortly after, the Astronomer Royal at Greenwich found that it left all other clocks far behind, but neither of them had the means for ascertaining the full perfection of the clock. For these means the world is indebted jointly to Mr. Loomis of Tuxedo Park, New York, and to Mr. W. A. Marrison, already mentioned. Mr. Loomis obtained in the year 1928 three Shortt clocks and set them going in a constant temperature enclosure, and I had the good fortune to assist him in setting up the first. Owing to the uniformity of temperature in the clock room ($\pm 0{\cdot}02^\circ$ C.), these clocks have a better chance of proving their value than many others; but even though they might go better, the degree of perfection indicated in the analysis by Prof. E. W. Brown (of Yale) and Mr. Dirk Brouwer could never have been ascertained without the ceaseless record of each clock every half minute by the Loomis spark chronograph. Even so, the perfection of going could not be known without the use of the quartz clock in New York connected by private wire with Tuxedo, forty miles away. The quartz clock 'ticks' 100,000 times a second, and 1000 time signals a second are sent by it along the line. These are made to actuate the spark arm and the motor which feeds the paper of the spark chronograph. When in the United States, I had the opportunity of meeting Mr. Marrison and hearing from him the whole story of his quartz clock, and of seeing it, in so far as it is possible to see anything. Mr. Marrison's account of this research, published by the Bell Telephone Co. the following year, appears to me to be of such outstanding interest that the Physical Society of London might well reprint it, with Mr. Marrison's permission.

Now the degree of perfection to which I have been leading up is no less than the certain observation of a six-hourly fluctuation of rate of the pendulum clocks under the influence of the moon's gravity. This is vouched for by Prof. Brown and Mr. Brouwer, and it needed the unvarying rate of the quartz clock and the thousandth of a second accuracy of each record of each clock every half

minute to bring this out. At the latitude of Tuxedo the calculated accumulated error of a pendulum clock at lunar six o'clock is −0·000153 sec. as compared with lunar noon and midnight, and this is certainly shown by the clocks. There are, of course, other effects of the moon, but the agreement between the gravitational disturbance of the clocks observed and calculated leads the authors of the paper to conclude that these others very largely neutralise one another. They give the following way of realising what the figures mean. "The same effect would be produced if the clocks were given a vertical oscillation with a semi amplitude of 2·5 inches and with the same period. An amplitude of 1 inch could be detected in a month's observations."

This is such a triumph that the four who have made it possible—Hope-Jones, Shortt, Loomis, and Marrison—might well believe that the limit has been reached, and rest; but it is certain that none of them will. C. V. BOYS.

Fluid Motion.

(1) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aerodynamik.* Teil 1: *Strömungslehre und allgemeine Versuchstechnik.* Herausgegeben von Ludwig Schiller. Bearbeitet von J. Ackeret, A. Betz, J. M. Burgers, A. Busemann, H. Falkenhagen, H. Mueller, H. Peters, L. Prandtl, H. Schmiedel, O. Tietjens, W. Tollmien. Pp. xii + 730. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 68 gold marks.

(2) *Mécanique des fluides.* (Cours de l'École Nationale supérieure d'Aéronautique.) Par Prof. Henri Villat. Pp. vii + 175. (Paris: Gauthier-Villars et Cie, 1930.) 50 francs.

(3) *Elementary Applied Aerodynamics.* By T. G. Whitlock. Pp. viii + 242. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 12*s.* 6*d.* net.

(4) *Flow and Measurement of Air and Gases.* By Alec B. Eason. Second edition, thoroughly revised. Pp. xii + 254. (London: Charles Griffin and Co., Ltd., 1930.) 20*s.* net.

THE study of fluid motion, both theoretically and experimentally, has made rapid progress during the last two decades. On one hand, the general recognition of the laws of dynamical similarity has led to a better appreciation and to a closer co-ordination of the experimental results, and on the other hand, the introduction of certain simplifying assumptions by Prandtl has led to a development of hydrodynamic theory which is remarkable both for the width of its applicability and for the accuracy of its predictions. The study of the boundary layer by theoretical analysis and by a highly developed experimental technique has explained many phenomena of fluid motion which were hitherto obscure, and the extension of the conception of a perfect fluid to include the possibility of circulation round a body, accompanied by a system of trailing vortices, has led to successful theories of the behaviour of the wings and propeller of an aeroplane.

(1) This collective work gives an excellent account of the present position of the theory of fluid motion and of the experimental methods which have been developed for studying the motion. From this wealth of material it is perhaps invidious to choose individual items for special mention, more particularly since different readers may be mainly interested in the development of the theory, in the relationship between theory and experiment, or in the experimental technique.

A brief introductory article by Prandtl precedes a long section by Falkenhagen in which are developed the fundamental equations of fluid motion and those special conceptions which are necessary for the comprehension of the subsequent articles. Vortex motion naturally occupies a prominent position, whilst other items of special interest are the theory of Bjerknes' pulsating spheres and the full account of the various attempts to calculate the viscous drag of a sphere, including Goldstein's recent extension of Oseen's solution. Two articles by Tollmien on the boundary layer theory and on turbulent motion give a clear insight into the theories which have been developed from Prandtl's fundamental conceptions, and they provide a valuable review of the position which has been reached in this branch of aerodynamics. The boundary layer theory is now firmly established, and it has the merit that it advances without any empirical aids other than the fundamental conception that the action of viscosity is confined effectively to a narrow layer round a body and to its wake. The theory of turbulent motion, on the other hand, is developed by statistical and semi-empirical methods the validity of which is more open to question, and, although Prandtl's conception of a *Mischungsweg* has led to several interesting and valuable developments, the precise significance of this length is still rather obscure. The theory of the motion of a compressible fluid is also less highly developed, but Busemann gives a clear

account of the subject and of the methods of investigating the compression waves which occur when the speed of a body through the fluid exceeds the speed of sound.

The sections dealing with experimental technique explain very thoroughly the measurement of pressure and velocity, and their value is enhanced by the clearness of the illustrations. Remarkable progress has been made in the technique of studying the details of the motion in the narrow confines of the boundary layer, and in the methods of making the flow pattern visible and of recording it photographically. These developments are described in Burgers' article on the hot-wire anemometer, which explains the theory and use of the instrument, and in Tietjens' account of various methods of studying and recording the flow pattern.

(2) This book is of a purely theoretical character and its aim is to develop in a precise form the fundamental theorems of hydrodynamics which constitute the basis of modern theories of fluid motion. M. Villat achieves this object in a clear and concise manner, but it is perhaps to be regretted that he has not found space to include a discussion of Prandtl's theory of the boundary layer. The development of the Kutta-Joukowski theorem, which is the basis of the theory of aerofoils in two dimensions, is perhaps the most interesting feature of the book, owing to the discussion of the singularities which arise when the theorem is applied to a straight line, to the explanation of the paradoxical results derived when the theorem is applied without due care, and to the extension of the theorem to a cylindrical body with isolated point vortices in the surrounding fluid. Other novel features are the proof of Kármán's expression for the drag due to a vortex street and the treatment of the problem of discontinuous flow.

(3) Textbooks of aerodynamics are few in number and generally assume an advanced knowledge of mathematics in the reader. Mr. Whitlock has now written an elementary book which forms a very good introduction to the subject. From the nature of the book it is necessary to accept many results without proof, but the author has succeeded in explaining in a simple manner the theories of the aerofoil and airscrew, the methods of estimating the performance of an aeroplane, and the factors which govern its stability. An occasional looseness of expression may be forgiven, but Mr. Whitlock has fallen into a serious error in introducing the moment coefficient and centre of pressure, owing to uncertainty in his convention of signs. It is regrettable also that he has used an old standard atmosphere, which was replaced by the present international standard some ten years ago.

(4) The fourth book, intended for practical engineers, is of a very different character, and deals mainly with the flow through pipes and the operation of pneumatic tubes. Mr. Eason appears to have read a vast number of original papers and to be acquainted with the latest theories of fluid motion, but he makes no serious attempt to analyse his material critically. A large part of the book consists of a succession of brief notes on the original papers, without any discrimination between experimental results which are old or new, good or bad, fundamental or trivial. The book undoubtedly contains much useful information, but one is left with the feeling that Mr. Eason has devoted too much energy to collecting the material and too little to writing the book.

Applied Entomology.

A History of Entomology. By Prof. E. O. Essig. Pp. vii + 1029. (New York: The Macmillan Co., 1931.) 42*s.* net.

THIS well-produced volume, replete with information and references, is in some ways both unique and exhaustive. Within a compass of rather more than 1000 pages there is related practically everything that is worth recording, and also much that is trivial, respecting the rise and development of applied entomology in the State of California. The point of view of the book is, therefore, essentially western American. The author explains this in the preface, partly on the ground that the historical growth of the subject is much less known in the west than elsewhere in the United States. California has kept well to the fore in applied entomology, and is one of the most highly progressive States of the Union in this respect. This, however, scarcely justifies the disconcerting title borne by the book, and the absence of any sub-title which might proclaim its actual scope.

Prof. E. O. Essig is a leading entomologist in the New World, and the volume before us bears the impress of his characteristic thoroughness and intimate knowledge of his subject. Of the ten chapters into which his book is divided, it will suffice to refer to the more important only. Chap. v., which deals with the injurious insects and mites occurring within the confines of the State in question, amounts almost to a manual on the subject, in its completeness and extensive bibliographies. Chap. vi., which is concerned with biological control, constitutes an authoritative

detailed record of the many experiments undertaken in California. This State, it may be added, was the first to apply biological control on a commercial scale. Chap. vii., on insecticides, describes their history and methods of application, and will interest those specially concerned with this branch of insect control. The longest chapter in the book is Chap. ix., "Biography", which runs to just over 270 pages. It includes biographies of most North American leaders in entomology, besides a fair number of Europeans. The latter, however, form rather an odd assortment of names, and their sole connexion with California is often on the strength of having described species that occur within the confines of its territory.

The final chapter (Chap. x.) is a tabular chronological series of dates showing the development and progress of entomology in relation to history and other sciences. Commencing with the birth of Columbus (1446 ?), it carries us finally into the year 1929. A great deal of painstaking research must have been involved in ascertaining and correlating all the dates and events that are recorded. It is, however, often difficult to discriminate in these tables between events and incidents of obviously different values, and many seem to be of rather local interest. In conclusion, it may be said that the scope of this volume embraces much of North American applied entomology. We think that its chief value will be as a reference book, which economic workers will need often to consult, since it is a veritable mine of information difficult to obtain elsewhere. A. D. I.

Short Reviews.

The Poetic Impression of Natural Scenery. By Dr. Vaughan Cornish. Pp. vii + 90 + 4 plates. (London: Sifton Praed and Co., Ltd., 1931.) 6*s.* net.

IN this little volume, dedicated to the Earl of Crawford and Balcarres, president of the Council for the Preservation of Rural England, Dr. Vaughan Cornish treats us to a succession of word pictures of homeland and foreign scenes, arranged in three chapters: i. Watching the Seasons; ii. To the Hills; iii. Across the Ocean. There are four beautiful photographs: The Breaking Wave; Bad Weather among the Mountains; The Rushing Torrent; The Placid Lake. The spirit of the book may best be given in the fine words of the author's preface: "The physical features of the landscape are but the warp of the garment of beauty in which the world is clad, the weft is woven by the changing light which sweeps o'er hill and dale. I have watched these varied incidents in many lands, and as the years roll on, the beauty of the Natural Scene makes an ever-deepening impression on my mind, until in later life the transient harmonies of light and landscape are not only the revelation but the image of eternal values."

Here Dr. Vaughan Cornish, a scientific observer, comes prominently to the fore as a poet and nature-mystic, a dual capacity which is happily becoming easier to adopt in these days when the old hard and fast distinctions between the different spheres of reality are tending to break down. At any rate, we strongly recommend the book to all who feel that there is more in a landscape with all its moods and expressions than can be reduced to purely physical terms; to all who if they were told that the difference between the mountains, let us say, when they have withdrawn into themselves asleep in the tranquil haze of fair weather, and the mountains when they are looming forth, glaring at one another in a stormy light, belonged entirely to the 'subjective' realm, would answer with calm assurance that this only begged the question, shifting it further back.

L. C. W. B.

Dixième Conférence de l'Union Internationale de Chimie, Liége, 14-20 septembre 1930. Rapports sur les hydrates de carbone (glucides). Pp. 287. (Paris: Union Internationale de Chimie; London: Hachette and Co.; H. K. Lewis and Co., Ltd.; David Nutt, 1931.) 50 francs; 9*s.*

THIS publication affords in a convenient form a really valuable collection of eleven papers dealing with various aspects of the chemistry of carbohydrates. These were read at a discussion which took place at Liège, in September 1930, during the tenth conference of the Union Internationale de Chimie. The wide range of the field of chemistry here concerned, its theoretical and technical importance, and the international character of the contribution under notice become evident from a mere glance at the list of contents. The papers deal with the history of monosaccharides (Bertrand), the ring structure of carbohydrates (Haworth), correlations of optical rotatory power and structure (Hudson), mutarotation (Lowry and Smith), starch (Pictet), structure of polysaccharides (Karrer), molecular weight of complex polysaccharides (Pringsheim), X-ray studies of polysaccharides (Mark), the relationship between the properties and applications of cellulose (Heuser), cellulose and its derivatives as colloids (Duclaux), and the relationship of the physical properties of artificial silk to the raw material and the methods of preparation (Viviani).

The publication calls for a cordial welcome, with one qualification: namely, that "the horrible nomenclature of a biochemical committee of the Union"—to quote the justifiable description of Dr. E. F. Armstrong—has been adopted, according to which carbohydrates are called 'glucides', and mono-, di-, and poly-saccharides disguise fair nature under the name of 'holosides'. Fortunately, 'silicides' had already been appropriated!

J. R.

Voice and Personality. By Prof. T. H. Pear. Pp. x + 247. (London: Chapman and Hall, Ltd., 1931.) 10*s.* 6*d.* net.

PROF. PEAR has a place of his own among contemporary psychologists. His mind does not work on orthodox academic lines, and his writings are all the more refreshing on that account. Armed with his psychological equipment, he attacks such problems as remembering and forgetting, work and play, and study—topics that appeal to the whole educated public. In the present volume he brings together the results of preliminary research on a subject neglected by the ordinary systematic psychologist, the subject of voices, and of their significance as expressive of personality. Anyone who has had experience of interviewing candidates, or who has tried to analyse the secrets of success on platform or in pulpit, is aware of the subtle effects of voices; and in our time, broadcasting, the sound-film, and the gramophone specially suggest the study of voices.

We do not wonder, therefore, that the subject has occurred to Prof. Pear as an interesting and promising field of research. He would be the last to claim that this piece of pioneer work takes us very far, and he would be the first to insist that, as is usually and properly the case with pioneer efforts, he raises far more problems than he solves. That he has written an interesting book on an elusive subject there can be no doubt.

Gmelins Handbuch der anorganischen Chemie. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 59: *Eisen.* Teil A, Lieferung 3. Pp. 314-586. 40 gold marks. Teil B, Lieferung 3. Pp. 513-656. 24 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1930.)

THE third section of Part A of the volume on iron opens with a discussion of passivity, of which a comprehensive review has been attempted. Then follows the corrosion of iron, chiefly under the influence of aqueous solutions. The compilers apologise for any shortcomings in dealing with corrosion, which they ascribe to a certain lack of co-ordination between the work of different investigators in this field. The latter half of the section deals with the technical production of cast-iron and of wrought-iron. A valuable feature is the inclusion of a list of patent specifications, which will be of great use to those who are engaged in the industry.

The third section of Part B deals particularly with the carbonyls, carbonates, acetates, and derivatives of other organic acids, including the ferro- and ferricyanides, the complex cyanides alone occupying 100 pages.

Organic Chemistry for Medical, Intermediate Science and Pharmaceutical Students. By Prof. A. Killen Macbeth. Second edition. Pp. xiv + 296. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 6*s.* 6*d.*

IN its second edition Prof. Macbeth's book has been revised and expanded from 235 to 296 pages, and extra chapters have been inserted on unsaturated hydrocarbons and urea and its derivatives; apart from these changes, the features of the original edition of 1920 have undergone no alteration which calls for comment. In his prefatory remarks the author expresses his opinion that the inclusion of descriptive experimental work in a theoretical textbook is of very doubtful value; many teachers will maintain, however, that the dependence of theory upon experiment cannot be over-emphasised in an exposition of this subject.

The book affords a clear and logical presentation of the fundamentals of organic chemistry which will appeal to the beginner, particularly if he leave for a second reading such topics as the synthetic uses of acetoacetic ester, the ethylene isomerism, space formulæ of sugars, γ-fructose, and the molecular structure of starch.

Annales de l'Institut Henri Poincaré: recueil de conférences et mémoires de calcul des probabilités et physique théorique. Vol. 1, Fasc. 3: *Quelques problèmes de mécanique quantique,* par M. Born; *Quelques propriétés d'une équation aux dérivées partielles hyperbolique,* par Marcel Brillouin; *Sur quelques problèmes non résolus de la physique mathématique classique, Propagation de la fusion,* par Marcel Brillouin. Pp. 205-308. (Paris: Les Presses universitaires de France, 1931.) 35 francs.

THE third fascicule of volume one of the *Annales* of the Henri Poincaré Institute is devoted to the lectures given at the Institute by Prof. M. Born and by Prof. M. Brillouin in 1929 and 1930. Prof. Born deals with quantum mechanics, using the matrix method to show, for example, how naturally the statistical interpretation of quantum mechanics may be developed, how it may be applied to the disintegration of the radioactive atom and to the difficult problem of the width of spectral lines, which has recently been dealt with by his pupil Dr. V. Weisskopf. Prof. Brillouin directs attention to the difficulties in the way of solutions of the problems of the motion of a uniform ocean acted on by a periodic force, and of the propagation of solidification within the crust of an otherwise molten earth. Neither problem has yet been solved satisfactorily.

Helgoland und die Zerstörung seiner Felsküste durch das Meer. Von O. Pratje. (Geologische Charakterbilder, herausgegeben von Prof. Dr. K. Andrée, Heft 38.) Pp. 15 + 12 Tafeln. (Berlin: Gebrüder Borntraeger, 1930.) 24 gold marks.

THE assurance of geographers that Heligoland is bound to disappear by marine abrasion was used by Lord Salisbury in defence of its retrocession to Germany in exchange for the growing asset of the extending Tana delta. The coastal features of Heligoland are illustrated in this brochure by photographs of the picturesque stacks and natural arches, of the plane of marine denudation, of the undercutting of the cliffs and its acceleration by the effect of organisms, and of the faults in the Triassic rocks. One plate shows views of one place before and after a large rock fall. Each illustration has an explanatory title in English as well as the fuller description in German.

Population and Production.*

By Prof. EDWIN CANNAN.

THE economic history of the last hundred years began with developments which threw great discredit on the fundamental assumption of the old school, that the extension of human occupation of land necessarily meant that less fertile and less well-situated land must be occupied as numbers grew. It was easy for men who saw arable cultivation creeping over barren hills in England and stony 'bogs' in Ireland to believe in that theory when Chicago was a collection of Indian huts and Broadway, New York, a rough cart track to a farm, but the application of steam to ships and railways enabled mankind to extend easily over an immense area of land more fertile than much of what was occupied before. As for situation, not only did the improvement in transport, coupled with the violations of natural geography involved in the cutting of the great ship canals, bring the 'more distant' lands nearer the 'market', but it also eventually brought 'the market' to the 'more distant' lands.

Later in the hundred years, scientific discovery in various directions has led to a complete change of emphasis in regard to the importance of what the old economists used to call 'improvements'. Modern science has changed our outlook. We set no bounds to the possibilities of improvement. We expect to make unwholesome areas healthy, and to modify vegetable as well as animal products so that they will better serve our needs. We smile now at the suggestion made from the presidential chair of the British Association in 1898, that very soon the world would be suffering from a shortage of wheat.

Thus, even if we still expected population to increase very rapidly, we should not believe, as J. S. Mill did, that it "everywhere treads close on the heels of agricultural improvement, and effaces its effects as fast as they are produced" ("Principles", Bk. 4, ch. iii. § 5). But, in fact, Cotter Morison's cry, made only a generation ago, that all would be well if only we could stop for a few years "the devastating torrent of babies" now seems grotesque, for we do not now expect rapid increase of population to continue much longer, even if it becomes progressively easier to obtain subsistence.

The approach of reduction in the rate of growth of population began to show itself in England in the second half of the 1871–80 decade, when the annual number of births became nearly stationary after the rapid increase recorded down to 1876. But the public takes little notice of the supply of people furnished by the births. Just in the wooden way in which illiterate farmers and unbusiness-like old ladies look at their balances at the bank, so the public looks at the censuses. The census of 1881 showed an increase of 14·36 per cent in the decade, which was higher than that shown by any of the censuses except those of 1821 and 1831, which were probably unduly swollen by the diminishing incompleteness of the enumerations. In 1881–91, in spite of high emigration, the rate of increase only dropped to 11·65 per cent, so rapid increase of population was still regarded as the normal thing which everyone should expect.

I had noticed, however, that the old rapid increase in the annual number of births seemed to have come to an end, and, working on the ages of the people as recorded in successive censuses, I put before Section F of the British Association, at its meeting in Ipswich in 1895, a paper (afterwards published in the *Economic Journal* for December in that year) in which I estimated the number of persons who would be living at each census up to that of 1951 on the assumptions that migration, mortality, and—not the rate—but the absolute number of births remained stationary. I found that on these hypotheses the population of England and Wales would stop increasing during the present century, and would have only a trifling increase after 1941.

Hostile critics derided what they called my "prophecy", and for some time events were unfavourable to me. Emigration fell off enormously, mortality decreased, and the births increased slightly, so that the census of 1901 showed an increase of 12·17 per cent in the decade, the absolute increase of three and a half millions being the largest recorded. But the situation was not fundamentally altered, since the increase of births was due entirely to the drop in emigration, which had caused a larger proportion of persons of parental age to remain in the country. In the *Fortnightly Review* of March 1902, I returned to the charge with an article on the "Recent Decline of Natality in Great Britain", in which, using a method of weighting the annual numbers of marriages by their proximity to the births recorded for each year—a method which seems to have been beneath the notice of the mathematical statisticians of that period—I was able to show, I think, conclusively, that the number of children resulting from each marriage was falling steadily and rapidly, and insisted with more emphasis than before on the "considerable probability of the disappearance of the natural increase of population—the excess of births over deaths—in Great Britain within the present century".

The decade 1901–11 was indecisive; the ratio of increase was smaller than in any of its ten predecessors, but the absolute amount of increase just topped that of 1891–1901, and the number of births until 1908 or 1909 seemed to indicate some recovery of natality. But this was illusory. Even before the War the births had got down again to the level of 1876. The War sent them tumbling down to about three-quarters of that number, and now, after a wild but very short-lived recovery when the Army returned from abroad, they seem inclined to settle at the War figure—three-quarters of the number attained more than fifty years ago, when the total population was twenty-six millions instead of forty

* From the presidential address, entitled "The Changed Outlook in Regard to Population, 1831–1931", to Section F (Economic Science and Statistics) of the British Association, delivered in London on Sept. 25.

millions, as it is now. The ratio of births, legitimate and illegitimate, to my weighted figure of marriages which was just over 4½ fifty years ago, fell gradually and steadily to 3¼ before the War caused it to collapse.

Diminution of infant mortality mitigates the effect of decline of natality, but the degree in which it can do so obviously decreases as the rate of infant mortality falls. When that rate is 500 per thousand, as it probably was in England in the reign of Queen Anne, and may be still in great parts of Africa, a cutting down of births by 25 per cent can be counteracted completely by a drop of one-third in the infantile mortality rate. But when the infant mortality rate is down to 100 per thousand, it would have to fall to nothing at all in order to counteract a decline of only 10 per cent in the number of births. In fact, the rate has fallen in England and Wales from about 140 to about 70 in the fifty years from 1881, and this drop to one-half only balances about one-fifth of the decline in the number of births.

Though there were eminent dissentients only a few years ago, statisticians are now agreed that, in the absence of some great and unexpected change, the increase of population in England and Wales will come to an end at a very early date. Even the lay public has been to some extent enlightened and rather shocked by the recent census announcements that the population of Scotland has actually decreased in the ten years, and that of England and Wales has increased only 2,061,000, as against 3,543,000 in the ten years from 1901 to 1911, though the emigrants have been 324,000 less.

The same change is observable in some degree in other western European countries and our own oversea offshoots. The cause of it—birth control—will doubtless in time affect the rest of the world, so that while we may expect considerable increase—even an increase much more rapid than at present owing to decrease of huge infant mortality—to take place among the more backward peoples for another half-century at least, there is no reason whatever for expecting the population of the world to " tread close on the heels of subsistence " in the future, even if it may be correctly regarded as having done so in the past.

This change in our expectations involves many changes of emphasis, both in the theory of production and in that of distribution. Two of them are perfectly obvious. First, the need, which J. S. Mill and most of his contemporaries and immediate predecessors felt so strongly, for insisting on the due restriction of population, has completely disappeared in the western countries. Economists do not now require to talk as if the first duty of men and women is to refrain from propagating their race. Secondly, the need for insisting on the desirability of saving has become less pressing. A rapidly increasing population requires a rapidly increasing number of tools, machines, ships, houses, and other articles of material equipment in order merely to maintain without improving its economic condition, while at the same time the maintenance of a larger proportion of children renders it more difficult to make the required additions.

There are, however, other changes of equal importance which are more likely to be overlooked. One is in regard to the weight which we attach to the different kinds of production. In the middle of the eighteenth century ' subsistence '—and what we should consider a very coarse and inadequate subsistence—probably seriously deficient in vitamins, appeared so much the most important economic good that the French *économistes* insisted on calling all labour which did not get something out of the soil *stérile* or barren ; and our own Adam Smith, with all his common sense, while admitting the manufacturing class into the ranks of ' productive ' labourers, insisted on excluding domestic servants, physicians, guardians of law and order, and all other workers who did not make up material objects, or who were not employed for profit (he never was quite sure which criterion he meant to stand by). The great Christian philosopher, Paley, believed that nothing more than a " healthy subsistence " was required for perfect happiness.

All this emphasis on food is now out of date. We no longer look forward to a future in which an increasing population will be forced by the operation of the law of diminishing returns to devote a larger and ever larger proportion of its whole labour force to the production of food. We know that even in the past, with a rapidly increasing population, the returns to agricultural industry have increased so much that civilised mankind has been able to feed itself better and better, while giving a smaller and ever smaller proportion of its whole labour force to the production of bare subsistence ; and we can reasonably expect that the increase in the productiveness of agricultural industry will be at least as great in the future, so that under the combined influence of the " narrow capacity of the individual human stomach " and the stationary number of stomachs, not only a smaller and ever smaller proportion but also a smaller and smaller absolute number of workers will be able to raise food for the whole.

Even the politicians, who for the most part follow the economists with a sixty or seventy years' lag, are beginning to realise the change, and are losing their enthusiasm for schemes for " settling more people on the land ", either in colonies or at home, and thereby increasing the already excessive depreciation of agricultural compared with manufactured products. The numerous subsidies which they still give to agriculture are mostly of an eleemosynary character intended to relieve distress, and the encouragement which they give to agricultural production is only an incidental effect, unintended and often deplored. They are defended, not on the ground that they increase food, but because they are supposed to increase employment.

The necessary change of emphasis applies not only as between food and other things, but also as between most primary and most finishing industries. In face of rapidly growing knowledge and slowly growing or stationary population, it is inevitable that the ' staple ' or ' heavy ' industries which provide materials should decline relatively to those which provide finished goods and services. The

demand for each of such things as pig-iron and yards of cloth is easily satiated; and so also is the demand for cricket-bats and chauffeurs. But the minor or 'lighter' industries are susceptible of an indefinite multiplication which makes the demand for their products, taken as a whole, insatiable. Increase a person's power of spending, and he will not increase his purchases in weight or bulk so much as in refinement of form, so that a richer people will devote a less proportion of their labour to producing things like pig-iron and bricks. Moreover, the mere fact of the disappearance of rapid increase of population tends to increase the proportion of demand which can be satisfied from scrap without fresh primary production. So, given a stationary population with rapidly increasing knowledge applied to production, we may expect the already observable tendency towards a less proportion of the whole labour-force being employed in the 'heavy industries' and a larger in the lighter industries to become more pronounced. Perhaps we see this even now in the slight drift of industrial population from the north to the south of England which appears to be taking place.

Another change of emphasis, of little importance on the Continent, where the West-Ricardian theory of rent never took real root, but of great importance in England and other English-speaking areas, is in respect of the landowners' share of the community's income. The disappearing bugbear of diminishing returns carries away with it the vampire rural landlord, who was supposed to prosper exceedingly when diminution of returns made food scarce and dear. The famous passage in which J. S. Mill described the landlords as they appeared to him and the school which he, a little belatedly, represented is well known:

"The ordinary progress of a society which increases in wealth is at all times tending to augment the incomes of landlords; to give them both a greater amount and a greater proportion of the wealth of the community, independently of any trouble or outlay incurred by themselves. They grow richer, as it were, in their sleep, without working, risking, or economising" ("Principles", Bk. 5, ch. ii. § 5).

Perhaps the disciple went a little beyond his master, Ricardo, in asserting so roundly that in a prosperous society the landlords must tend to get a larger and ever larger *proportion* of the whole income, but there can be no doubt that this was the impression which the Ricardian school conveyed to the public, and which formed the foundation for Henry George's scheme of land nationalisation and the agitation for land-value taxation. If the school had only meant to teach that the land became more valuable absolutely—in the sense of being worth a larger absolute amount of commodities rather than a larger proportion of all the commodities and services constituting the community's income—they could not have supposed land so peculiar, since it would share this characteristic with many other things—with anything which was more limited in supply than the generality.

To grasp the completeness of the change of view which has taken place in the last hundred years, we must notice that Mill and the whole school which he represented were thinking not of the few lucky landlords who have inherited land which has been selected by Nature or accident as the site of a city, but of the ordinary rural agricultural landlords. So far have we moved that the land-value taxers of to-day quite cheerfully propose to exempt all 'purely agricultural value' from the imposition which they advocate.

Envy of the happy owners of such urban land as rises in value more than enough to recoup what they and their predecessors in title paid in road making, sewering, and other expenses of 'development' plus loss, if any, in waiting for income, still plays a part in contemporary politics, but the economist foresees that there will be at any rate less of such rise of value when the adult population ceases to increase and the demand for additional houses and gardens consequently disappears. He realises that if any such rise continues, it will be due to the people being not only able, as they doubtless will be, to occupy a larger area with their houses and gardens, but also desirous of doing so. He will think this quite possible, but will not be confident about it, when he reflects that the vast spread of 'villadom' may be only a temporary phenomenon, and that the married couples of the future, childless or with small families, may be more content with flats in towns and little bungalows with tiny curtilages right in the country.

The disappearance from economic theory of the picture of the vampire landlord taking an ever-increasing proportion of the whole produce of industry, which was itself decreasing per head of workers, leaves the theoretical arena open for discussion of the sharing of the whole produce between earnings of work and income derived from possession of property of all kinds.

As to this, the economists of a hundred years ago had nothing to say. The socialists, who followed them in fact the more closely the more they denounced them, failed completely to clear up the confusion, and it dominates the mind of the lay public even now—much, I admit, to the discredit of the economists, who should have taught that public better.

While there are no statistics on the subject worth much, and none covering any considerable area either of place or time, past history is sufficiently known to assure us that increasing civilisation has, in fact, made the aggregate share of property grow faster than that of labour, the obvious cause of this being that useful things constituting property have grown faster than population, and so much faster that what decline of the rate of interest has taken place has not been sufficient to counteract the tendency.

There is nothing to show that this tendency will be either reversed or intensified by a cessation of the growth of population. The cessation will, of course, tend to reduce the desirability of additional equipment; a large part of the additions of the past have been required simply to enable the additional people to be provided with tools, houses, and other instruments of production or enjoyment. But

additions to equipment will be made with less sacrifice of immediate enjoyable income than before, so that the increase of quantity may be sufficient to counteract the decline in the value of the units. Moreover, it is quite impossible to say what the tendency of invention may be in the future—whether to enhance or to diminish the value of additional material equipment.

The history of the last hundred years suggests that this question of the division of income between property and labour is losing whatever importance it possessed. The economists and socialists of a hundred years ago were little removed from the time when it was common to talk of 'the labouring poor', as if society was fairly sharply divided into poor workers on one side and rich owners of property on the other. How innocent the mass of the people were of the crime of owning anything may be realised if we recall that none of the agencies with which we are familiar for enabling them to invest had then got beyond the embryo stage. Friendly societies, co-operative societies, building societies, savings banks, are all modern growths.

The present position is that, while many of the working-class have become property owners, many of the propertied class have become the paid servants of public companies and other institutions. Hence the old sharp distinction between the wage-earner and the capitalist is become a thing of the past, and the division of income between property and labour is no longer a division between two classes composed of different individuals, but a division between two sources of income largely possessed by the same individuals.

Thus, in distribution, emphasis on the old categories of land, capital, and labour is rapidly becoming obsolete and is being replaced by emphasis on individual riches and poverty, however arising. It is no longer the lowness of standard earnings that worries the philanthropic economist, but the fact that so many people are unable to rank themselves among recipients of those wages. Emphasis is on unemployment.

Unemployment is not really a very modern phenomenon. But, so far as I know, it has never been contended that history shows unemployment to be greater when population (or even population of working age) is rapidly increasing. Yet it is common to talk of 'the difficulty of providing employment for a rapidly increasing population', and some eminent authorities quite recently endeavoured to console the public by alleging that the coming decline in the growth of numbers will greatly alleviate the present situation in regard to unemployment.

I believe this to be a profound error, based on an elementary misconception of the origin of demand. The old proverb "With every mouth God sends a pair of hands" is true and valuable, but no more so than its converse, "With every pair of hands God sends a mouth". The demand for the products of industry is not something outside and independent of the amount of products. The demand for each product depends on the supply of products offered in exchange for it, and the demand for all products depends on the supply of all products. Consequently, there is not the slightest danger of the working population ever becoming too great for the demand for its products taken as a whole.

Unemployment arises not from insufficient demand for the products of industry as a whole, but from the number of persons offering to work in particular branches of industry being in excess of the number admissible, having regard to the conditions and wages which are required to satisfy both the would-be workers who are unemployed and the persons already in employment. If the unemployed will not take what employers would offer them, the case is simple, and it is only a little more complicated if they are willing to take, and the employers are willing to give, something less than what is paid to the persons already employed.

Now one of the commonest causes of such a situation is a falling off of demand for the products of a particular branch of industry. The fact that the demand for any product, let us say coal, for example, falls off, is a good reason for fewer persons being employed in that branch of industry and more in other branches. If the diminution of demand is very gradual, the necessary reduction in personnel can be effected by a cessation of recruiting. Many a branch of industry has gradually wilted away in this manner without much inconvenience or hardship to anyone. But if the diminution is more sudden, unemployment results owing to the natural reluctance of persons skilled, or at any rate experienced, in the particular branch of industry to leave it and try for employment in some other.

The thoughtless outsider is apt to say that both the unemployed and those who are still employed in the branch should accept lower wages, and so, by cheapening the product, extend the demand for it. As a temporary palliative this may sometimes be reasonable, but it is evidently never the best final solution of the difficulty. It is not reasonable that a trade should be continuously worse paid than others merely because the demand for its products was once bigger than it has become. What the diminution of demand calls for is a redistribution of labour force, fewer persons being allotted to the branch of industry of which the products are less in demand, and more persons to the other branches.

When population is increasing, absolute diminutions of demand are likely to be somewhat fewer, and somewhat less acute when they do occur, than when population is stationary. If, for example, by the introduction of oil, or more economical consumption, the average person's demand for coal is reduced by one-tenth, in a stationary population the total demand for coal would be reduced by one-tenth; but if the population in the same time increased 12 per cent, the total demand would be not reduced but slightly increased, and there would be no employment difficulty.

We ought, therefore, not to imagine that a stationary or declining population will rid us of the trouble of unemployment. It will provide more rather than less reason for promoting mobility of labour in place and occupation.

The Recorded Data of Science.

A FAVOURITE simile likens the growth of modern science to the rise of a great edifice which, in its different parts, presents to the world a variously incomplete appearance. The broad foundations have long since been laid, and immense pillars already stand erect upon them, whilst there are sites where excavation has not yet laid bare unyielding rock, and places where surveyors have condemned an unsound structure. It is an inspiring picture, but the architects and the masons need something more than inspiration. Their work cannot be based on impressions ; it requires plans, records, specifications, quantities, and the clerks and draughtsmen in an obscure office contribute in full measure to the success of the enterprise. The picture is incomplete unless it exposes the weakness of what appears to be strong and discloses the content of what might be taken for hollow space ; moreover, if it has regard for truth, it must give due prominence to the dust of time which lies heavily on the joints and conceals their true relation to the frame. Only the written records reveal the exact condition and the manner of construction of the building, and the written record affords, after all, the essential preparation for every scientific expedition.

Knowledge cannot safely move forward without first retracing its steps and surveying its path ; the searcher cannot safely plunge into the unknown until he has acquainted himself with the known. We are not for the moment concerned with the adequacy or otherwise of that acquaintance, although a survey of scientific journals would quickly provide material for discussion ; we have in mind the bibliography of the literature of science, the service of abstraction and compilation, and the great importance of accessibility, as well as preservation, of scientific records. It is not sufficient to commit results to paper ; it is not sufficient to publish them in a widely read journal, even in a widely understood language. When the journal has been placed on a shelf beside its fellows, and a more recent issue takes its place on the desk, it is the turn of bibliographers, abstractors, and indexers to make their essential, if unpretentious, contribution. The work has to be performed without intermission, and it should be entrusted to those who are able to combine an appreciation of the significance of the subject matter with experience in the art of its treatment.

This desideratum applies not only to the preparation of standard publications of reference, but also to that of reports for the use of individuals and of scientific and industrial corporations. If the results attained by former investigators are to be of service in future research, they must be sought, identified, collected, and preserved, and this is a task of great and increasing magnitude. It is satisfactory, however, that the wider need for expert assembly and use of such records is being realised, and that the growth of libraries is being accompanied by the establishment of a branch of the profession of librarianship trained and exercised in the functions of special libraries and information bureaux. The efficiency of such organisations, and the solution of their special problems, cannot fail to be influenced by the establishment of appropriate facilities for training and practice ; neither can it be denied that scientific research and industrial progress must inevitably reap the advantage.

We have been led to discuss special librarianship by our reflections on the position of scientific literature as a tool in research, reflections which originated from our having occasion to refer to the "Annual Tables of Constants and Numerical Data for Chemistry, Physics, Biology, and Technology", a publication based on work which has been in progress internationally for twenty years. The origin and history of the enterprise, which is at the same time an outstanding addition to the literature of science and a demonstration of international co-operation in the cause of science, were fully explained by the secretary-general, M. C. Marie, in a lecture delivered in 1928 before the Swiss Chemical and Physical Societies. Dr. Marie then pointed out how much important numerical information is buried in papers the titles of which gave no indication of its presence, and hence is easily overlooked. On his report to the seventh International Congress of Pure and Applied Chemistry held in London in 1909, a commission was appointed and immediately commenced its labours. At first the literature was examined by a large number of collaborators, but this method proved inexpedient, so that since 1912 a different procedure has been employed. There is now appointed in each important country at least one representative, who prepares slips referring to numerical data and forwards them quarterly, together with parts of the relevant literature of that country, to the editors who (with the assistance of experts in each subject class) are responsible for the extraction of the data ; hence the inhomogeneity of the earlier volumes is largely avoided.

The publication was at first confined to the data of physical chemistry, but it soon became obvious that its scope must be extended to include pure and applied sciences specified in the title, which still does not refer to important sections such as mineralogy and crystallography. Only data concerning substances or definite systems are recorded, data lacking adequate precision being referred to only in the bibliographies ; for it is useless to record figures which have no significance. Obviously, there can be no invariable rule, and the limits must be fixed by experience, but with this provision the aim is "to publish everything in the physical and natural sciences and their applications that can be represented by numbers". Apparent inhomogeneity due to the coexistence of two forms of classification—according to the nature of the con-

stant, and according to the nature of the substance —is retained in order that information of particular interest to groups of specialists may be presented in a convenient form. Thus the properties of rubber are conveniently found in the same part of the engineering section, and not dispersed among the chapters on density, viscosity, etc. As befitted an international work published in Paris (Gauthier-Villars et Cie), the tables were originally printed in French, although certain introductory pages bore translations in English, German, and Italian. Commencing with volume 7, however, the international character of the work has been emphasised by the presentation of the complete text in both English and French, whereby its sphere of usefulness will naturally be extended.

The convenience not only of English-speaking peoples, but also of specialist groups, has been considered. To an increasingly great extent, workers in particular branches of the tree of knowledge require special assemblies of numerical data to facilitate their researches and to save them wearisome hours in sifting their particular needs from those of their colleagues. This demand has been supplied by the publication of separate sections on spectroscopy, electricity, magnetism, electrochemistry, mineralogy, crystallography, etc., the possession of which may in many cases render superfluous that of the complete volumes.

Research workers themselves require no admonition to secure access to works of reference such as the "Annual Tables", which derive their value not only from their contents, but also from their lacunæ. These gaps may be due to commission or omission. As Dr. Marie points out, inadequate specification of the conditions of measurement may render the results of that measurement completely worthless; moreover, it is only when scientific information concerning the properties of matter is arranged in an orderly manner that missing and weak links in the chain can be quickly detected. Hence the work of compilation of a complete record, when carefully performed, must to a certain extent stimulate criticism, and must therefore lead directly to advances in our knowledge concerning the material criticised. So also the record itself is a source from which critical tables may be, and have been, derived. Dr. Marie refers to the snare of those values which merely masquerade with an air of 'precision', but he is careful to insist that incompatibility must never be condemned unexamined, and cites as a cogent example the unsuspected reason for such incompatibility in determinations of the density of nitrogen. On the other hand, the "Tables" are not selective, although the service rendered by similar selective compilations is not overlooked by their editor, who, however, aims at catholicity.

The first three volumes surveyed the data published during 1910, 1911, and 1912, but the early progress of the undertaking was soon to be interrupted by the outbreak of the War, and inevitable delay resulted; nevertheless, by 1922 the fourth volume (1913–1916) was published, and was followed in 1925 by the fifth (1917–1922), in 1928 by the sixth (1923–1924), and in 1930 by the seventh (1925–1926) volumes; the first part of volume 8 (1927–1928) and volume 9 (1929) are due to appear in 1931, and the second part of volume 8 early in 1932. In February last the work was enriched by the publication of a collective index to the first series (vols. 1-5), and a similar index to the second series is announced for 1933. The index is tripartite, comprising an analytical, an alphabetical, and a formula index; with its aid numerical data published between 1910 and 1922 for more than 20,000 substances can be readily traced under the French name; whenever necessary, English, German, and Italian names are also given. Thus recovery from the War and its aftermath is all but complete, and the delay in the accessibility of the data will soon be no greater than the natural hysteresis between original and collective publication. Even such delay as is now imposed can be circumvented, for the editorial organisation necessarily constitutes a bureau of information, to which individual application for assembled but unpublished information may be made.

In his lecture, Dr. Marie gave some account of the financial basis of this international enterprise. An early conviction that independence of commercial interests was essential led to the refusal of an attractive proposal made by a German publisher; of the subscriptions received at this period, specially honourable mention is made of two: a modest sum from a society of students in Uppsala and a substantial donation from the Imperial Academy of Sciences of Vienna, the good example of which was followed by other scientific bodies. In 1918, with the view of the publication of the fourth volume, a French fund was established; in 1922 the financial basis was broadened by the creation, at the instance of the Union Internationale de la Chimie pure et appliquée, of an international scheme providing for subvention in relation to population. So far as is possible, the government of each respective country sponsors the subscription; the British contribution is provided by the Royal Society. In this way sums sufficient to permit the publication of vol. 5 were gradually collected, whilst the preparation of certain subsequent volumes was facilitated by subventions from the International Education Board and from French industrial organisations; in 1928 Dr. Marie was able to announce that the financial undertakings given by various countries would, so far as could be seen, permit the "liquidation of the past".

It would be ungrateful to describe the work and the organisation in so nearly impersonal terms; Dr. Marie's present collaborators—E. Cohen (Utrecht), P. Dutoit (Lausanne), A. Egerton (Oxford), O. Scarpa (Milan), F. K. Richtmyer (Ithaca), and C. J. West (Washington)—deserve the thanks of the scientific community, which will remember also with equal appreciation the names of Abegg, Bodenstein, Bruni, Stieglitz, Washburn, and Wilsmore in connexion with the creation of what is equally a worthy example of international work and a work of international worth.

Cancer Research.*

THE British Empire Cancer Campaign continues to subsidise a great variety of investigations into the cause and treatment of cancer, and the progress which is being made is summarised fairly fully in the recent annual report.

The greatest practical advance in the cancer problem which has been made in recent years is the cumulative demonstration that tar and soot and, generally, the products of burned coal, together with certain mineral oils, have an exceptional efficiency in causing malignant tumours when they are applied to the tissues of men and animals over long periods of time. The evidence comes partly from experiments on animals and partly from studying the relation of cancer to occupation and mode of life. The two lines of inquiry are entirely concordant in implicating burnt coal, and they provide sanitarians with a clear indication for preventing some forms of cancer.

For experimental purposes tar has generally been used as a carcinogenic agent, and a good deal of research has gone into the obvious question as to what particular substance in that complicated mixture is responsible. Most of the components have been tried and found to be inert, and no pure substance has been found which had anything like the effect of tar. It seems now, however, that Mr. I. Hieger and Dr. J. W. Cook, at the Fulham Cancer Hospital, have made substantial progress by following up the observation that benzanthracene and cancer-producing tar have similar fluorescent spectra. They have since found that 1 : 2 : 5 : 6-dibenzanthracene in a high state of chemical purity readily produces cancer when applied in quite small concentrations to the skin of mice, and they have thus provided a most valuable method for the analysis of the precise mechanism by which such cancers are produced. Whether this or some analogous compound is in fact the active agent in tars and mineral oils is not known.

There is at any rate no obvious justification for the statement made in the Report of the Grand Council (though not, we notice, by the workers themselves) that " the essential molecular structure of the cancer-producing agent in tar and other cancer-producing substances " has been determined. It may well be that the agent is not the same in all tars and carcinogenic oils. Cancer of the skin may be produced experimentally by X-rays, freezing, burning, acids, and other procedures which irritate the skin and have no 'substance' in common, though they may be similarly active because they all lead to the tissues producing the same active agent.

Another inquiry which relates the chemical constitution of a substance to its capacity to cause the growth of cells has been carried out by Dr. J. S. Young at Leeds. Solutions of simple salts injected into the pleural sac stimulate the cells lining the marginal alveoli of the lung to proliferate, and their efficiency in a general way varies with the valency of the metal: aluminium is more effective than calcium, and calcium than sodium. To these interesting facts he has now added the observation that cells which have reacted once are refractory to a further application of the stimulating salt for about three weeks. This resistance may also be induced by a series of injections of gradually increasing strength such that no reaction is at any time produced: ultimately the cells tolerate a concentration of the salt twice as great as that required to cause a reaction in a normal animal. This kind of cellular immunity to irritating substances is little understood and needs further investigation, possibly on simpler material than that used by Dr. Young.

While these and other data indicate quite clearly that cancer is essentially a local disease due to local causes, it is also evident that general or constitutional factors may be involved. In the present report, for example, it is shown that some strains of mice respond more quickly to the application of tar than others, and mention is made of a breed in which tumours appear 'spontaneously' in an extraordinarily large percentage of animals. Dr. C. E. Dukes also presents the pedigrees of a number of human families in which a hereditary predisposition to the development of multiple innocent tumours of the bowel is plainly shown: in many cases these growths form the starting point of cancers which appear at an exceptionally early age. It may probably be presumed that by deliberate dysgenic mating, strains of men might be produced with a special tendency to respond to external irritants by the growth of cancers, but there is no evidence that the constitutional factor is of any substantial importance in an ordinary human society, except in a few special instances such as that studied by Dr. Dukes.

* British Empire Cancer Campaign, Eighth Annual Report of the Grand Council, presented at the meeting held at the House of Lords on July 20. (London: British Empire Cancer Campaign.)

Obituary.

DR. JOAN B. PROCTER.

SELDOM has the triumph of force of mind over physical weakness been more vividly illustrated than in the case of Dr. Joan Beauchamp Procter, curator of reptiles and amphibians in the Gardens of the Zoological Society of London, who died at her residence in Regent's Park on Sept. 20, at the age of thirty-four years.

Fragile from birth, she still persisted in her duties, first at the Natural History Museum and later at the Zoo, when the majority in like position would excusably have retired.

From quite early days she had dedicated her abilities to the subject which was to become her life's work. As a child she showed an extraordinary interest in reptile and amphibian life,

snakes, lizards, and frogs taking the place of diversions more usually associated with the nursery —and often causing consternation and alarm amongst her relatives and visitors. Whilst still at St. Paul's Girls' School, she called upon my father, Dr. G. A. Boulenger, F.R.S., who at that time was in charge of the reptile and amphibian collections at the British Museum. He at once perceived in her the makings of a brilliant herpetologist, and when she left school he invited her to work under his direction. Her special capabilities found full vent, and so valuable was her assistance that when my father retired, in 1920, Miss Procter was given the management of the vast collection. She proved not only an admirable systematist, but also an accomplished draughtswoman and modeller, and was responsible for some of the showcases in the Reptile Gallery in the Natural History Museum, and for a large series of coloured postcards of reptiles on sale at the Museum.

In 1923, Sir Peter Chalmers Mitchell, secretary of the Zoological Society, asked her to assist me in the design of the rockwork of the new Aquarium, then in course of construction, and later invited her to take over the curatorship of the Reptile House —the Aquarium at the time monopolising all my attention. As curator of reptiles she was an unqualified success, her great knowledge of reptiles coupled with her remarkable manual dexterity enabling her to perform many surgical operations on her charges that had not hitherto been attempted. The new Reptile House, opened in 1927, may fairly be regarded as a lasting monument to Miss Procter and her work. It combines the most modern developments of heating, lighting, and general hygiene, all of which she was quick to appreciate. The house, moreover, blends scientific requirements with artistic embellishment in a manner that had not hitherto been attempted in any zoological collection. During her curatorship at the Zoo she turned her artistic abilities to full account, and the majority of the more modern buildings and enclosures in the Regent's Park menagerie bear her stamp. The Reptile House, however, is pre-eminently her achievement and a worthy climax to an all too brief career.

Amongst her many contributions to scientific literature, her monograph on that remarkable tortoise *Testudo loveridgei*, published in the *Proceedings of the Zoological Society* in 1922, may be specially mentioned.

Miss Procter will be mourned by all those who were privileged to come into personal contact with her. A larger number outside her immediate circle will miss an artist and a valuable contributor to knowledge—one who did so much and in so brief a period. E. G. BOULENGER.

SIR GREGORY FOSTER, BT.

SIR GREGORY FOSTER, whose death occurred on Sept. 24, at the age of sixty-five years, was a singularly able and devoted worker in the cause of education and of university education in particular. He entered University College, London, as a student in the 'eighties, graduating in 1888. He studied afterwards under ten Brink at Strasbourg, obtaining the degree of Ph.D. He was for some time professor of English at Bedford College, which was then situated in Baker Street, London, and he returned to University College as secretary and lecturer, becoming principal (afterwards provost) of the College in 1900, and holding that appointment until his retirement in 1929. In 1928 he was elected vice-chancellor of the University of London and was re-elected to that office in 1929. The greater part of his life was therefore spent in connexion with University College and the University of London.

The period during which Foster was provost of University College was one of the most notable in its history. The status of the College was altered by its incorporation in the University in 1907. Under his guidance its position was extended and consolidated in a remarkable degree. Existing departments were strengthened and new departments created, new chairs were established, and many additions of great importance were made to the curricula. The School of Librarianship and the Department of Scandinavian Languages owe much to him. The magnificent range of laboratories in connexion with the Department of Chemistry, the great buildings devoted to the medical sciences, and the Architectural and Engineering Departments are among the most important university buildings erected in England in recent years. Foster would have been the last to claim that he was primarily responsible for this remarkable growth in the equipment and resources of the College, for he preferred to give the credit to others. The College is not likely, however, when honouring his memory, to forget the part he played or the great gifts of leadership which he displayed.

Foster was devoted to the interests of the students, and he carried on and developed the work begun by Henry Morley, for whom he had a great admiration, in fostering a corporate life in the College. He was a strict disciplinarian, but his innate kindness brought instant and unobtrusive help to many, of all nationalities, who were in difficulty. Thus, in spite of the reserve which gave him his dignity of bearing, he won the popularity which comes to fearless and humane men who do not seek it. He gave himself without stint to the College, and its welfare and advancement were ever in his thoughts. He never spared himself. Possibly he worked too hard, for he was unwilling to delegate to others any duty that he thought important, and in the opinion of his friends he would have been wise to have 'let go' when, a few years ago, his health showed serious signs of strain. He never lost his early interest in philological studies, in which he doubtless would have made his mark had not other duties engrossed his attention.

Although primarily concerned with University College, Foster was interested in many educational questions generally. He was always a staunch friend to the cause of women's education, and when he became vice-chancellor of the University of

London he was concerned with the facilities offered to medical women and generally with improving residential and social facilities for London students. Until quite recently, as chairman of the Council, he was endeavouring to raise funds for College Hall for Women in Bloomsbury. He had always been a prominent advocate of reform in the constitution of the University, of which he was a devoted son, and the University was fortunate in that at the difficult period of transition from the old statutes to the new he was, in the position of vice-chancellor, able to bring about the necessary changes with the least possible friction.

His health had not been good for some little time, but he endured the pain and inconvenience of illness with fortitude and fine courage. He will be greatly missed and not soon forgotten. E. D.

MR. J. W. TAYLOR, of Leeds, who died on Sept. 2, in his eighty-seventh year, was the doyen of British conchologists and was responsible, more than anyone else, for the intensive study of our land and fresh-water Mollusca. He founded the *Journal of Conchology* in 1874, and with some of his friends (of whom Mr. H. Crowther still survives) established the Conchological Society in 1876. In 1894 he began the publication of his "Monograph of the Land and Fresh-water Mollusca of the British Isles", probably the most complete account of any group of animals which has been attempted, and beautifully illustrated by himself. The second volume, written in conjunction with W. D. Roebuck, is the only satisfactory description of British slugs. Unfortunately, with less than half completed, publication has been suspended since 1921. Mr. Taylor was a printer, and received the degree of M.Sc. from the University of Leeds in 1915.

WE regret to announce the following deaths:

Dr. Francis Barnard, honorary curator of coins and medals in the University of Oxford and formerly professor of medieval archæology in the University of Liverpool, on Oct. 9, aged seventy-six years.

Prof. C. L. Bristol, emeritus professor of biology in the University of New York, known for his researches on the marine fauna of Bermuda, on Aug. 27, aged seventy-two years.

Sir Arthur E. Cowley, fellow of Magdalen College, Oxford, and late Bodley's librarian, on Oct. 12, aged sixty-nine years.

Prof. J. B. Goesse, *S.J.*, emeritus professor of geophysical observations in the Saint Louis University and founder of the geophysical observatory of the University, on July 25, aged sixty-two years.

Prof. J. Long, formerly professor of dairy farming at the Royal Agricultural College, Cirencester, a well-known agricultural writer, on Oct. 1, aged eighty-five years.

Prof. Richard A. F. Penrose, jr., formerly professor of geology in the University of Chicago, and formerly a member of several State geological surveys and also of the U.S. Geological Survey, on July 31, aged sixty-eight years.

Prof. James T. Porter, head of the Department of Physics in the University of Tennessee, on Aug. 27, aged fifty-seven years.

News and Views.

IT was widely believed in the seventeenth century, even by Otto von Guericke for example, that air could be condensed into a watery liquid by compression. The origin of this belief is discussed in a note by Prof. E. O. von Lippmann in the *Chemiker Zeitung* for Sept. 5. He points out that the transformation of air into water is implied in early Greek philosophy and in Aristotle's theory of the elements, but he thinks the transmission of the belief is to be ascribed to Lucian (second century A.D.), who, in his satirical "True History", relates how a ship was blown by a whirlwind on to a star, from which the shipwrecked travellers saw the earth below as a shining sphere. The inhabitants of this star took as food only the vapours of flying frogs roasted over fires, and as drink, air condensed to a liquid in vessels by pressure. Lucian, who is generally supposed to have no claim to originality, may have derived the idea from some unknown earlier writer. In amplification of Prof. Lippmann's interesting note, it may be added that the writings of Lucian (available in an excellent English translation by H. W. and F. G. Fowler: Oxford, 1905) contain many such hints, concealed by the very artificial style of the author. Lucian refers, for example, in the same "True History", to a peace treaty between the inhabitants of the sun and moon, engraved on a tablet of electrum and set up on the frontier between their territories. This undoubtedly refers to the use of electrum, as an alloy of gold and silver, as a kind of neutral material combining the properties of both gold and silver, which are associated with the sun and moon respectively. Electrum, however, is referred by contemporary and later neo-Platonic writers to a separate planet, Jupiter or Mars, and the date of its removal from the list of planetary metals and replacement by the metal mercury has been discussed (for example, by Berthelot) without mention of Lucian's hint. There are several other similar references made by this author which are of interest in the history of science.

DR. H. MARTIN LEAKE, in the *Contemporary Review* for September, voices a plea for the establishment of biology on the basis of a real profession. Of late years there has arisen a widespread demand for trained biologists, due to the post-War development of the Colonies, which lie mainly in the tropics. The demand exceeds the supply, and this is not adequately explained by lack of educational facilities. The basal trouble appears to be the lack of that security of tenure and emolument which is essential if workers of the right calibre are to be attracted to biological

study. At present the biologist has such a restricted and specialised market for his services that security is attained only under the wing of other professions. His work is chiefly needed in connexion with agriculture, which is beginning to substitute a firm scientific foundation for the empiricism which has hitherto been the guiding principle for the majority of those practising agriculture as a profession.

As Dr. Martin Leake remarks, the upsetting of the balance of Nature in colonial development has raised a multiplicity of field problems needing investigation by trained research workers, and under present conditions it is only the Government which is in a position to provide the necessary funds, which will thus entail a single employer, the Colonial Office. A few other interests, especially tea and rubber, have begun to employ biologists, but so far the demand from such quarters is too small to affect the professional question. Dr. Leake indicates the need for a link between research and practice, the fact that the generalisations of research frequently need interpretation with local requirements, and that the research organisation does not replace, but complements, the technical staff within the commercial unit. Such a development, if it took place on a scale materially to affect the system of agricultural production in the tropical Empire, would do much to improve the status of biology as a profession, would increase the demand for trained biologists, would provide security and adequate remuneration, and would remove the dangers inherent in the concentration of demand for services in the hands of a single employer.

AT the opening of the School of Pharmacy of the Pharmaceutical Society, which is also the School of Pharmacy of the University of London, on Oct. 7, an address to the students was delivered by Prof. G. E. Gask, of St. Bartholomew's Hospital Medical School and dean of the faculty of medicine of the University of London. Prof. Gask spoke on the decline of traditionalism. The address dealt in the main with the evolution of pharmaceutical education in Great Britain, indicating how in pharmacy as in other sciences there has been a progressive departure from old-established traditions, a process which has in recent years proceeded with increasing speed. It is the duty of the universities to encourage this. For hundreds of years the mind of man has been fettered by tradition. Advances were made in the nineteenth century, but they seem likely to be eclipsed by the achievements of this twentieth century, when the biochemist, the physicist, and the bacteriologist are daily contributing to the knowledge of the healing powers of Nature. Prof. Gask regards even these present advances as being transitional and as preceding even greater advances in the near future. The conditions of the present day do not favour a stereotyped, unprogressive civilisation, and to meet its requirements adjustment of thought and inventiveness are called for, and repeated criticisms of ourselves and our institutions.

AFTER Prof. Gask's address, a number of medals and prizes were presented by the president of the Society, Mr. A. R. Melhuish. The Hanbury Memorial Medal was presented to Prof. Hermann Thoms, of the University of Berlin. The medal, which is of gold, was instituted to commemorate Daniel Hanbury, whose name was well-known throughout Europe in the early half of last century for his accurate and painstaking investigations into the sources of vegetable drugs. The medal is awarded biennially by a Committee consisting of the presidents of the Pharmaceutical, Linnean, and Chemical Societies, the chairman of the British Pharmaceutical Conference, and one other member. The award is made "for high excellence in the prosecution or promotion of original research in the chemistry and natural history of drugs". Prof. Thoms, who is the twenty-third recipient of the medal and the first German to receive it for twenty-six years, commenced his academic career with his appointment to the Pharmaceutical Department of the Friedrich Wilhelm University in Berlin in 1895. In 1900 he was entrusted by the Ministry of Education with the planning of the Pharmaceutical Institute of the University of Berlin, which was completed in 1902, and of which he was the director until 1927. Throughout his life Prof. Thoms has been an assiduous and prolific research worker, specialising in the chemistry of naturally occurring drugs. He was the founder of the Deutscher Apotheker Verein and for many years its president. The Pereira medal, which is regarded as the *cordon bleu* of pharmacy, was presented to Horace G. Rolfe. This medal is awarded annually by the Pharmaceutical Society as the result of a competition among recently qualified pharmaceutical chemists. It was founded to perpetuate the memory of Jonathan Pereira, at one time professor of materia medica to the Royal College of Physicians and also to the Pharmaceutical Society.

THE annual paper-reading conference of the Agricultural Meteorological Scheme organised by the Ministry of Agriculture and Fisheries was held at the Meteorological Office, Exhibition Road, South Kensington, on Oct. 8 and 9—Sir Napier Shaw being chairman, as in previous years. The meeting was well attended by research workers in various branches of agriculture. It is customary for a member of the staff of the Meteorological Office to read the opening paper. On this occasion Mr. E. G. Bilham, superintendent of the section of the Meteorological Office concerned with British climatology, opened with an account of various meteorological developments having importance for agricultural research, including an account of work that is being carried out with the view of obtaining a very much more complete representation of the distribution of monthly normal mean temperature over the British Isles than has been available hitherto. The underlying principle of this work is that a comparatively short period suffices to fix the differences between the normal mean temperatures of neighbouring places; consequently, by comparing five-year means, of which a large number is available, using the indications furnished by a comparatively small number of places for which long-period normals are available as to the extent to which

the monthly means for the five years in question were abnormal, a large number of comparable normals are obtained. As was pointed out, in estimating the effects of temperature on various agricultural phenomena by modern statistical methods, it is essential to be able to state the former variable as a departure from the normal.

THE nine papers that followed were contributed by agricultural research workers, and covered a large range of subjects, from the influence of climate on soil composition to the effects of light, moisture, and temperature on the growth of various pests and vegetable disease organisms as well as that of the crops on which these are parasitic. Among these may be mentioned a paper by Mr. L. Iorwerth Jones, in which the interesting experiment was described of interchanging samples of the soils at two different Welsh research stations of very different altitude in order to test the effect of mere climatic influences upon the growth of various grasses. The results suggested that comparatively slight changes of temperature and rainfall suffice in order to pass from conditions highly favourable to a particular grass to those so unfavourable that germination cannot even be achieved. These matters are obviously of the first importance in the choice of suitable grasses for laying down pasture, for which considerations of soil can clearly be given too much weight. The general tendency of the researches described in these meetings was to establish humidity as being one of the most vital meteorological factors in controlling plant growth as well as plant pests, but in one or two of the papers the light factor took the first place.

THE Report for 1930 of the Botanical Society and Exchange Club of the British Isles, by the secretary, Dr. G. C. Druce, gives an account of the activities of the Society during the year, including excursions to Galway, Co. Clare, and other places of special botanical interest. Sir Maurice Abbot-Anderson contributes an appreciation of the late Princess Royal, patroness of the Society; "she was a great lover of wild flowers and made many delightful paintings of them". Her place as patroness has been taken by H.R.H. Princess Mary, Countess of Harewood. "Plant Notes" for the year by the secretary and other members of the Society include reference to plants new to the British Isles, with critical notes, partly original and partly culled from other publications; and a list of new county and other records occupies fifty pages. A hundred pages are devoted to several original papers. These include a monographic revision of the larger British pondweeds, by Dr. W. H. Pearsall, which will be invaluable to students of this difficult genus; critical notes on brambles by William Watson; and some notes on British orchids by P. M. Hall. A supplement of special interest to British botanists is an account by H. A. Hyde of Samuel Brewer and a copy of his diary made during his botanical exploration in North Wales in 1727. This has been compiled from the transcript in the Banksian collections at the Natural History Museum, compared with one by Hugh Davies (1776) which has recently been acquired by the National Museum of Wales. The secretary also contributes a number of notes on new publications, and obituary notices of botanists, mainly British, who have died during the past year; there is also a full account of Dr. Druce's eightieth birthday celebrations.

THE Report is a remarkable tribute to the virility and inexhaustible energy of the octogenarian secretary. The Botanical Society was founded by Dr. Druce to extend and amplify the work of the old Botanical Exchange Club, and under his fostering care has developed to become a valuable helpmeet to British field botany and a record of results achieved. Anxiety as to what might happen when, in the course of Nature, the secretary lays down his work is, to some extent, allayed by an announcement in the Report. Dr. Druce states that he has left his "house, herbarium, library, paintings and furniture, with an endowment and a curator, as a Botanical Institute for the use of Botanists and a help to our own Society". An advisory committee which has been appointed contains the names of several well-known British botanists.

FIFTY years ago the Field Naturalists' Club of Victoria, Australia, was founded by a small body of enthusiasts, and at its jubilee celebrations in July it properly congratulated itself on the progress made during the years. The Club has kept in the forefront the ideals of the field naturalist, although it has had many members whose work lay along more specialised lines, such as Sir F. McCoy the palæontologist, Sir Baldwin Spencer, zoologist and ethnologist, and the members of the biological departments of the University of Melbourne. By popular evenings for talk and discussion, wild-flower and wild-nature shows, by championing the conservation of fauna and flora, its members have encouraged, with practical results, a love for Nature in the State. It has successfully advocated reservations as sanctuaries for fauna and flora, and owing to its suggestions and influence, in spite of indifference and opposition, Wilson's Promontory was set aside as a national park for the people. The record is a good one, and we share with the editor of the Club's magazine, the *Victoria Naturalist*, the wish that the centenary of the Club may be celebrated, not in a rented building, but in its own building, a hall of natural history on a central site in Melbourne.

THE sensational recovery of a homing pigeon, liberated in France in August, at Saigon on Sept. 9, has been attracting considerable attention in the press, and the episode is certainly a remarkable one, because the bird was a yearling on its first trial flight, and yearlings are not expected even to take part in any long-distance races, to say nothing of crossing a couple of continents. There is no doubt about the identity of the bird, the wing of which, says the Paris correspondent of the *Daily Mail* in the issue of Sept. 28, was stamped with the name and town of its owner, M. Louis Rasson, Dottignies. The bird must, of course, have gone hopelessly astray at the start, and may have got out to sea and been kept, or

domiciled itself upon, an east-bound steamer; an Indian house-crow (*Corvus splendens*) has been known to board a homeward-bound steamer at Colombo, and remain with it until captured near Suez. But even if the passage were not assisted, the bird might work its way overland by consorting from time to time with other domestic pigeons and with the ancestral rock-doves, and thus learning how to find food and rest. In connexion with the long flights performed by these homing pigeons in races, it is a curious fact that the breed, which is, as opposed to the old black caruncu-lated carrier, a composite one evolved in the last century, should show a decided tendency to have shorter wings than the sedentary dove-cot pigeon. The wood-pigeon, however, though largely migratory, has wings very much shorter than the rock-dove, a very sedentary bird.

SIZE fascinates, so we read with interest a new account of the habits of the largest of the 1800 known species of earthworms, *Megascolides australis*. We thought them to be rare, but Charles Barrett (*Australian Museum Mag.*, July 1931, p. 238) says that the rich dairy lands and potato fields of the lower Bass Valley are so thickly populated that thousands are turned up by the plough, and there the dark brown egg-capsules, buried from a few inches to several feet, are most easily found. It is not known in what form the soil swallowed by the worm is ejected, but the progress of the creature through its burrow is marked by gurgling and sucking sounds sufficient to startle the hearer. This is partly due to the lubrication of the tunnel walls by cœlomic fluid, ejaculated from dorsal pores, and this also appears in thin milky-coloured jets when the worm is irritated. Only one bird, the kookaburra, has been known to eat the giant worms, and even for it the meal is unusual. The worms may be three-quarters of an inch in diameter; the average length is a little more than four feet, but an hour's digging may produce several specimens six or seven feet long; and the largest actually measured was 11 ft. long. Several excellent photographs illustrate the size and habitat of the worm, which was filmed by the author.

A GOOD deal of misapprehension as to the commercial value of linking up large electric power stations so that they can mutually help one another still exists. This misunderstanding seems to be the basis of much criticism of the 'grid' in Great Britain. In the *Journal of the Franklin Institute* for August, N. E. Funk, the engineer of the Philadelphia Company, which is connected to two other huge companies by a 220-kilovolt link, gives a clear statement of the economic advantages of interconnexion. Five years ago, eleven companies extending from Chicago, Ill., to Boston, Mass., were interconnected. This led to many misconceptions in the press. For example, one paper said "1000-mile hook-up gives Boston light. Electric power interchange between New England city and Chicago; test is step in the development of single line from coast to coast!" It is pointed out that if power were transmitted from Chicago to Boston the cost of transmission would be about 5*d*. a unit, which is many times larger than the cost of generation in Boston. Interconnexion between power stations is desirable for several economic reasons. It increases the trustworthiness of the supply and decreases the number of dynamos that have to be held in reserve. As a rule also, the maximum demands of the various linked stations occur at different times, and this diminishes appreciably the amount of plant required. Mr. Funk proves that substantial savings can be effected by considering the case of his own company. The Pennsylvania Company with which it is linked supplies a mining, industrial, and farming section of the State. The Philadelphia Company and the Electric and Gas Company supply densely populated districts with very diversified demands. A chart is given showing the flow of current in a link with the power station during the course of a day.

MESSRS. Lanchester's Laboratories, Ltd., of Spring Road, Birmingham, have issued a pamphlet describing their loud speakers designed suitably for different purposes. In a picture theatre, for example, an instrument of great power is required. Its acoustical distribution also must be practically perfect and must have no directional bias. The firm make a large public address outfit which will broadcast speech over a radius of a hundred yards in the open, every syllable being distinctly heard and the identity of the speaker being recognised. They also make a smaller model suitable for a small receiving set or a radio-gramophone in the home. When compared with the loud speakers on the market a few years ago, they show great improvements and a very considerable reduction in price. A helpful attempt is made to explain exactly what is meant by a 'decibel'. It is pointed out that this is the logarithm of a ratio and so is incorrectly described as a unit. In the appreciation of sound it takes a drop of twenty per cent in the intensity as received by the ear before it is noted that there is a drop of volume. Plus or minus one decibel is the least change of intensity that the ear will notice under the most favourable conditions. Without special attention, plus or minus three decibels is about the smallest difference that is noticeable. This corresponds to the wide difference of two-to-one in the energy received. It is fortunate that this is so, for when listening to an orchestra some of the audience owing to their positions hear the various instruments in widely different proportions. If it were not for the adaptability of the ear, the music would sound very differently in various positions. Very simple home tests are given for testing a loud speaker.

IN response to many urgent appeals from those interested in archæology and anthropology, the exhibitions arranged in connexion with the centenary meeting of the British Association, at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1, will remain open until Oct. 31. The Museum will be open each day, excluding Sundays, from 10.30 A.M. until 5.30 P.M., admission free. The Egyptian Exhibition includes the results of past seasons' excavations carried out by the Egypt Exploration Society at Tell el Amarna and Armant,

under the leadership of Mr. J. D. S. Pendlebury and Mr. O. H. Myers. A remarkable collection of ancient, rare, and precious jewels and ornaments from Egypt has been lent by foreign and British museums, as well as numerous collectors at home and abroad, in response to requests made by Dr. Robert Mond. Realistic models are extensively employed for the first time to illustrate the structure and character of ancient Egyptian palaces, tombs, and methods of excavation. In the Amarna Section, the head of a princess is a distinct acquisition to the art of the period; while the model of a nobleman's palace, like the reconstruction of a sacred bull burial from Armant, tells at a glance what hours of reading and study would not make clear. Associated with the Egyptian Exhibition is a noteworthy collection of photographic studies of various phases of South African life by Mr. Duggan-Cronin and Dr. L. Cipriani, of Italy. There is also the interesting exhibit from the English Folk Dance Society, illustrating customs of past centuries in England.

A NUMBER of very successful transmissions by television were recently carried out from a portable transmitter installed in a studio of the British Broadcasting Company. Arrangements have been made by the B.B.C. and the Baird Company to investigate whether a wire link can be used to carry the television signals in sufficient strength and purity to enable the North Regional Station at Slaithwaite to repeat the transmissions. Should these experiments be satisfactory, then it will be possible for owners of 'televisors' in the north to obtain very much better reception of television broadcasts than they have had up to the present. We learn from the October number of *Television* that the B.B.C. has agreed to admit television within the recognised programme hours. The transmission is being broadcast from a B.B.C. studio on one evening every week. Some of the radio artistes at the B.B.C. form the studio 'subjects', so that the owners of televisors are able to see them on the screen.

NEGRETTI and Zambra's new catalogue of meteorological instruments (List M.2) is a worthy successor to the firm's monumental catalogue of engineering and industrial instruments (List E.5) published about two years ago. It contains much useful information in regard to points of practical importance in the design and use of instruments and a number of references to published work. In the foreword it is made clear that very harmonious relationships exist between our biggest firm of meteorological instrument makers and the Meteorological Office. Without close and sympathetic co-operation between the official meteorological service and the instrument makers little could be achieved, and it is all to the good that there should be a free interchange of ideas. The result is that the ordinary purchaser can obtain from the maker instruments similar in every respect to those supplied for use at official stations, and can feel assured that they represent the result of years of endeavour to produce the most suitable type of instrument for the purpose it is to serve. Besides an ample choice of the usual instruments for meteorology, particulars will be found of aircraft and upper air instruments and also of test apparatus—a particularly useful section. In connexion with tube anemographs (pp. 16-17) mention should be made of the fact that a Meteorological Office certificate in respect to the recording unit can be supplied at a small extra cost. In the thermometer section the 'sheathed' pattern instruments M.2135, M.2136, and M.2176 are of special interest. The numerous advantages conferred by this type of construction have recently been recognised by the Meteorological Office and it has been adopted as the official pattern for use on land. It is due to Messrs. Negretti and Zambra to point out that they have listed similar instruments for many years. Prospective purchasers should note, however, that the Stevenson screen requires special fittings to support them.

THE Annual Congress of Radiology and Radiological Exhibition will be held at the Central Hall, Westminster, on Dec. 2–4.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. J. A. Baker, to be agricultural field officer, Malaya; Mr. J. N. Clothier, to be agricultural officer, Northern Rhodesia; Mr. H. M. Stent, to be assistant agricultural research officer, Northern Rhodesia; Mr. L. E. W. Codd, to be plant breeder, British Guiana; Mr. W. J. M. Irving, to be agricultural officer, Uganda; Mr. L. N. H. Larter, to be geneticist, Agricultural Department, Jamaica; Mr. P. Morrison, to be manager of the Government Fruit and Vegetable Bureau and supervisor of Agricultural Credit Societies, St. Vincent.

THE memory of the late Mr. Andrew Laing as one of the great engineers of this century, and of his activities in the cause of the advancement of the sciences of engineering and shipbuilding, are to be perpetuated by an annual memorial lecture to be given under the auspices of the North-East Coast Institution of Engineers and Shipbuilders. Mr. Laing, who died on Jan. 24, 1931, was the general manager and a director of the Wallsend Slipway and Engineering Co., Ltd. The memorial lecture is made possible through the munificence of the Misses Jeannie and Catherine Laing, who, being desirous that a special fund should be founded to perpetuate the memory of their brother, have transferred into the name of the Institution the sum of £2000 for the purposes of the lecture.

IN recognition of his outstanding work in the science of ornithology, particularly as applied to bird migration, Dr. Witmer Stone, vice-president of the Academy of Natural Sciences of Philadelphia, and curator of its department of vertebrate zoology, has been awarded the Otto Hermann medal of the Hungarian Ornithological Society, the highest honour conferred by that organisation, and one of the most significant of its kind. This medal commemorates the distinguished achievements of Dr. Otto Hermann, whose research

in bird migration gave him high rank among ornithologists, and whose death in 1914 was a world loss to this science. For many years he had devoted his entire time to an intensive study of zoology, especially bird life and habits, and it was largely through his efforts that the Museum in Budapest was developed to its present excellence.

THE ninth International Congress of the History of Medicine will be held at Bucharest, under the presidency of Dr. V. Gomoiu, next September, when the principal subjects for discussion will be (1) the evolution of medicine in the Balkan States and (2) the protection of Europe against bubonic plague. Those wishing to contribute papers on these or other subjects are requested to forward the title and a typed copy of a summary of their paper to the office of the Congress, Str. Stirbey Voda 86, Bucharest II, without delay. The official languages will be English, French, German, Italian, and Spanish. Members of the Congress can take the direct route to Bucharest or meet at Trieste, whence visits will be paid to Athens, Constantinople, and Constantza, where local committees will be arranged for their reception. The meetings of the Congress will occupy four days, and the following three days will be devoted to a tour of Bucharest and excursions in the neighbourhood. A programme will be issued later giving the exact date of the Congress and the amount of the subscriptions.

THE journal entitled *La Géographie*, published by the Société de Géographie of Paris, has had a career of more than a century in one form or another. It has now undergone another change, and with the September issue appears with the title of *Terre Air Mer*. In its new form it is to treat more of descriptive and economic geography; and to adopt a more popular outlook than of old. The illustrations are increased in number, and the detailed bibliographies seem to have been given up. An article on the influence of Pierre d'Ailly on Columbus is of interest.

ANOTHER series of the excellent post-cards illustrating British trees has been issued by the British Museum (Natural History), S.W.7, each set containing photographs showing the habits of the tree in summer and winter and coloured illustrations of the flower and fruit. With each set there is a description of the tree and of characteristics that have given its timber or other products a practical interest. These sets of four cards in a neat envelope at sixpence should find wide use in schools, and are well worth purchase by those interested in the common trees of the countryside. The term 'British' is employed to include various well-known and common trees which are, strictly speaking, not native; thus, the larch is included in these new issues. Now the number issued is becoming so extensive, it would be a desirable innovation if, with each set of four, a list of the trees available in the series were included.

UNDER the title of "Orthoptera Celebica Sarasiniana I." the supplement to Vol. 12 of *Treubia* (May 1931) contains a series of papers on the saltatorial Orthoptera of the Celebes. It deals with material obtained by the Sarasins a number of years ago, besides later discoveries made by others. The most extensive contribution is by Mr. H. H. Karny on the grasshoppers of the family Tettigoniidæ and their geographical distribution. This same authority also deals with the family Gryllacridæ, while Mr. L. Chopard writes on the Achetidæ and Gryllotalpidæ, and Mr. C. Willemse discusses the Acrididæ. While a number of new species are described, those already known and their respective genera are diagnosed in detail, and the descriptions are accompanied by numerous text figures illustrating various morphological features. The whole work, when completed, will form a comprehensive monograph of the Orthoptera of the Celebes, and will prove valuable both to students of the order and to entomologists interested in problems of geographical distribution.

THE Medical Research Council has issued a third edition of the "Catalogue of the National Collection of Type Cultures" (Special Rep. Series, No. 64. H.M. Stationery Office; 2*s*. net). The collection is maintained by the Council at the Lister Institute of Preventive Medicine, Chelsea Bridge Road, London, S.W., Dr. St. John-Brooks and Miss Rhodes being the curator and assistant curator respectively. The collection now exceeds 3000 different strains of micro-organisms, and cultures will be supplied so far as possible on application to the curator, a small charge being made to defray costs. The co-operation of microbiologists is invited, and they are asked to deposit in the collection not only new species or important strains of organisms but also strains of recent origin of the commonest types. Some particulars are given in the preface on the present position of bacterial classification and nomenclature and of the Nomenclature Committee of the International Society for Microbiology.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at the Training College for Teachers, University of Rangoon—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Oct. 22). A headmaster of the Euclid Street, Swindon, Secondary Co-Educational School—The Secretary to the Swindon Education Committee, Clarence House, Clarence Street, Swindon (Oct. 31). A professor of zoology in the University of Sheffield —The Registrar, University, Sheffield (Nov. 4). A Geoffrey Duveen travelling student in oto-rhino-laryngology at the University of London — The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A chief lecturer in chemistry at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. A teacher in charge of the chemical department of the Barnsley Mining and Technical College—The Principal, Mining and Technical College, Barnsley. A head of the department of civil and mechanical engineering of the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield.

Letters to the Editor.

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

The 'Lapides palmati' mentioned in the "Historia Naturalis" of the Elder Pliny.

PLINY, in Book 36, par. 134, in the course of a description of various minerals, says, "Palmati (sc. lapides) circa Mundam in Hispania, ubi Caesar dictator Pompeium vicit, reperiuntur, idque quotiens fregeris". (Stones marked with the pattern of a

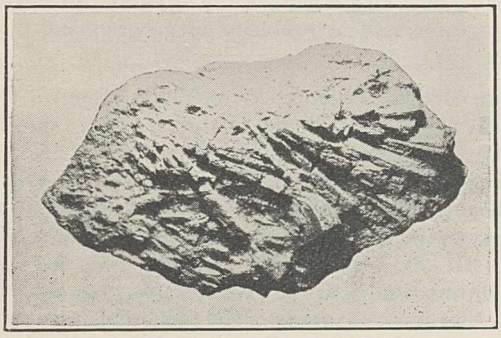

FIG. 1.—Andalusite in mica schist.

palm, which appears however often you break the stone, are discovered near Munda in Spain, where Cæsar, during his dictatorship, defeated Pompey.)

So far as I am aware, no attempt has been made to identify these stones, beyond the almost certainly incorrect suggestion that they were fossils of palm leaves. Munda, near which Cæsar defeated Labienus and Cneius Pompeius in 45 B.C., was situated in the province of Spain called Andalusia, and the aluminium silicate, andalusite, which derives its name from that locality, answers Pliny's description well and in two different ways.

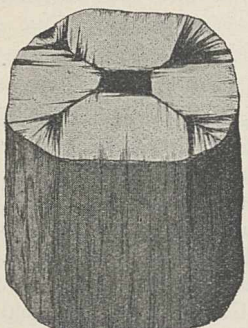

FIG. 2. — Chiastolite pattern. From Miers' "Mineralogy" (by kind permission of Macmillan and Co.).

In the first place, occurring in argillaceous schist, mica schist, and other rocks, it often forms radiating groups of prisms which bear a remarkable resemblance to branches with thin spiky leaves. Fig. 1 shows a specimen in mica schist from the Geological Museum of Trinity College, Dublin. Although, however, the words "idque quotiens fregeris" might describe the finding of a palm-like pattern of crystals when the parent rock is broken, it seems more probable that they refer to a still stranger property of the mineral. A variety of andalusite known as chiastolite (χιαστός, arranged diagonally) or macle (*macula*, a spot) consists of "stout crystals having the axis and angles of a different colour from the rest, owing to a regular arrangement of carbonaceous impurities through the interior, and hence exhibiting a coloured cross, or a tesselated appearance in a transverse section". The pattern is discovered wherever the crystal is split ("quotiens fregeris"), and Fig. 2, taken from Miers' "Mineralogy", p. 50 (second ed.), shows that the pattern may sometimes bear a great resemblance to palm branches. The chiastolite variety occurs, among other places, at Morbihan in Brittany, and Andalusian specimens, found in Pliny's day, may well have shown the phenomenon. Dana ("System Min.", 1904, p. 497), from whom the words in quotation marks are taken, reproduces pictures of other chiastolite patterns.

My thanks are due to Dr. Louis B. Smyth, and to my wife, for suggestions and assistance in arriving at this identification.

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Trinity College, Dublin.

Eclipse Plumage in the Mallard.

THE reasons for the changes of pattern, colour, and type in the plumage of fowls have been the subject of investigation by many workers and the parts played by testis, ovary, and thyroid shown. Work has also been carried out on ducks, the reactions of testis and ovary receiving most attention. Goodale,[1] Seligmann and Shattock,[2] Kuhn,[3] and others found little correlation between the eclipse plumage of the mallard and testis size and function or ovarian influence.

The experiments on ducks which I describe briefly below were undertaken because it was thought that a wider study of the relation between the endocrines and plumage modification would be profitable.

The mallard (*Anas boscas*) was chosen as being the most responsive material, the drake having two regular changes of plumage type during the year—eclipse plumage from May to September and mating or normal plumage from October to April.

The aim of these experiments was to produce the eclipse plumage in these drakes during their mating plumage season, October to April. Before each experiment, areas of feathers were plucked on breast and belly, and, in the pituitary work, on the flanks.

A start was made with thyroid, on the lines of the experiments of Greenwood and Blyth,[4] and others in which the colour of the neck hackles of the Brown Leghorn cock was changed from gold to black by the feeding of thyroid. No parallel change occurred in the mallards though a similar preparation was used and the amounts fed approximated to the higher dosages given to the fowl. The thyroid feeding appeared to cause only an alteration in the pattern rhythm of the growing belly feathers—their colour was unaltered and the breast feathers showed no change. It was noticed also that large single doses of thyroid that caused precipitate moulting in cocks had no similar effect on the drakes.

Pituitary was next tried. Desiccated anterior lobe suspended in saline was injected subcutaneously into drakes, with the result that the growing feathers in all plucked areas showed modifications in pattern and colour. Except in the breast feathers of two drakes, these modifications approximated to the normal eclipse plumage exhibited later by each drake.

At the same time other drakes were given subcutaneous injections of dried posterior lobe suspended in saline. Here, though there was modification in pattern and colour, the modified pattern and colour differed from the normal eclipse feathers shown later by each drake, from those produced by the anterior lobe injections, and from the modified pattern of the belly feathers produced by the thyroid feeding referred to above. There appeared to be a change of the pattern rhythm and intensity of pigment deposition.

Injections of whole pituitary gave varied results, and further work on this is being done.

These isolated results can contribute nothing conclusive to our knowledge as to the cause of eclipse plumage. Further experiments are in progress on the relation of the other endocrines to eclipse, mating, and female plumage. When these further experiments have been carried out and the full analysis is completed, it is hoped that interesting results on the subject of the endocrine modifications of plumage expression within the range of genetic determination will be obtained.

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[1] *Biol. Bull.*, 1910.
[2] *Proc. Zool. Soc. Lond.*, 1914.
[3] *Arch. für Geflüg.*, 1930.
[4] *Proc. Roy. Soc. Edin.*, 1929.

Change of Density of Carbon Disulphide with Temperature.

THE investigations of Isnardi [1] have shown that the value of the dielectric constant of carbon disulphide falls suddenly at −90°. This drop appears at a considerable distance from the freezing point (−112°), so the phenomenon shows an analogy to the change of the dielectric constant of ethyl ether with temperature. On the basis of this analogy, it might be reasonably supposed that the values of other physical properties of carbon disulphide would show similar abrupt if less marked changes at −90°.

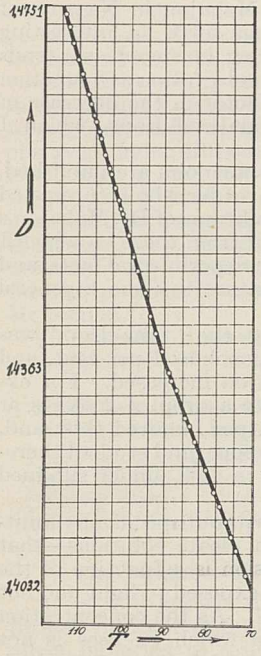

FIG. 1.

Experimental investigation has shown that on the heating curve of carbon disulphide there appears at −90° a distinct slowing down of rate of change of temperature. This suggests a change of the substance at this point from one liquid modification into another liquid modification. The analysis of the heating curve has enabled us to evaluate the latent heat for this change.[2]

The next step consisted in a study of the changes of density of carbon disulphide with temperature, with special attention to the neighbourhood of −90°. I have therefore measured the density of carbon disulphide, using the method described by Kamerlingh Onnes and I. D. Boks. The details of the experiment have been described by me in the communications concerning the densities of ethyl ether and nitrobenzene.[3]

The temperatures were determined with an error not greater than 0·003°. The position of the meniscus of liquid could be read with an error of about 0·2 mm.; this corresponds to an uncertainty of 1·5 mm.[3] in the value of volume of the liquid, so that, taking into account the volume of the dilatometer bulb, the relative error in the value of volume was about 0·1° per cent. The mass of the substance was determined with an error of about 0·0001 gm.; it follows that the values of the density were certain up to the fourth or even fifth figure.

As a freezing liquid I have used a mixture of ethyl ether and ethyl alcohol, mixed in a certain proportion. This mixture remains clear with the lowering of temperature, and it does not impede the motion of the stirrer even at −120°.

I may mention that the values of temperature were determined by means of the platinum resistance thermometers placed in the Dewar vessel at different depths. The determinations of temperature were made only after it was certain that the temperature was stationary throughout the volume of the freezing liquid. When the temperature of the freezing liquid was lowered down to −120° C., further cooling was stopped, whereas the stirrer remained in motion. Under the influence of the heat of the surroundings, the temperature of the carbon disulphide in the Dewar vessel increased slowly at the rate of about 1° per hour.

The carbon disulphide used in this investigation was very carefully purified, starting from the pure Cl_2 "pro analysi" delivered by Schering-Kahlbaum. The accompanying curve (Fig. 1) shows the change of density of carbon disulphide in the interval of temperatures between 112° C. and 70° C. It appears that with the lowering of temperature the density of carbon disulphide increases from the value 1·2628 at 20° up to 1·4363 at 90°. At this temperature there begins a more rapid increase of density with lowering of temperature. In the neighbourhood of the freezing point the density has the value 1·4751.

It appears, therefore, that at the point of change from one to the other liquid modification of carbon disulphide the density curve shows a distinct change of slope.

J. MAZUR.

Physical Laboratory, Technical Institute,
Warsaw, July 20.

[1] *Zeit. für Phys.*, **9**, 153; 1922.
[2] M. Wolfke and J. Mazur, NATURE, **127**, 926; 1931.
[3] J. Mazur, NATURE, **127**, 270; 1931; and **127**, 893; 1931.

Deep-Focus Earthquakes.

MR. F. J. SCRASE [1] has recently found confirmation of the great depth assigned to certain earthquakes by the late Prof. H. H. Turner by recognising, in the data of the International Seismological Summary, the two separate branches of PR_1 and SR_1 that are to be expected if the focus be deep, and by observing the substantial agreement of their travel-times with the expected times calculated on the basis of the Zoeppritz-Turner tables. It may be of value to note in this connexion that we may, by the use of these reflected pulses, arrive at what is certainly a minimum value of the depth of focus, and this independently of any previous travel-time tables and even of any error in the assumed time of origin. This would eliminate any objection that might possibly be made to the use of the Zoeppritz-Turner tables.

All that is needed is good curves, derived from the data of the earthquake being investigated, showing the arrival times for P and for pP (this latter being the notation suggested by Scrase for a P wave reflected close to the epicentre). It will be seen from such curves that the interval $pP - P$ gradually increases with increasing epicentral distance, though the two curves soon become nearly parallel. At a distance of 180°, where the slope of the two curves becomes equal to zero, the interval would represent exactly twice the time required for a wave to travel from focus to epicentre. Curves extending to that distance are not generally obtainable. However, we may choose a point where the two curves are almost parallel,

say at 90°, and the perpendicular distance from a point on the P curve to the pP curve will approximate to the distance between the curves at 180°. By a suitable correction this approximation can be made still more exact. Hence, if this given distance corresponds to a time interval of 100 sec., we know that the focus is at least at such a depth that a P wave requires 50 sec. to travel to the epicentre. Multiplying this time by an average value of the velocity at moderate depths, we arrive at a value for the depth of focus. The above-mentioned interval of 100 sec. would thus indicate a focal depth of approximately 400 km.

Records from observatories throughout the world for an earthquake of March 29, 1928, have yielded very satisfactory curves for P and pP, for S and sS, as also for other pulses. The uncorrected distance between the P and pP curves corresponds to an interval of 92 sec., so that great depth of focus seems well established. Several other features of the records point in the same direction. This conclusion is further confirmed by Wadati's assignment,[2] on the basis of the records from the nearby Japanese stations, of extraordinary depth to this shock.

It is felt that the admission of the occurrence of earthquakes at depths of the order indicated must entail interesting consequences for speculations in regard to the earth's structure and constitution.

V. C. STECHSCHULTE.

University of California,
Berkeley, California,
Aug. 31.

[1] *Proc. Roy. Soc.*, A, **132**, 213-236, July 1931. See NATURE, **128**, p. 228, Aug. 8, 1931.
[2] *Geophysical Magazine* (Tokyo), **2**, p. 18, March 1929.

A Counting Device for Use with the Geiger Counter.

THE most trustworthy instrument for recording the impulses delivered by a Geiger counter is no doubt a string electrometer. Since, however, the counting of the deflections on a photographic record requires a good deal of time, a mechanical summation will in general be preferred. The arrangement to be described here has the advantage of being so simple that

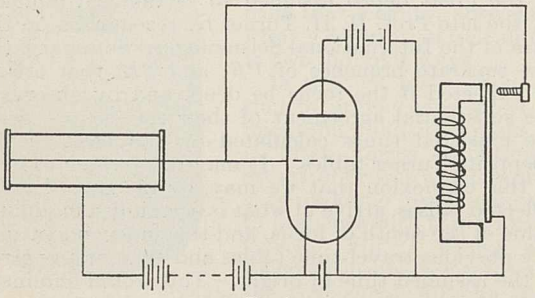

FIG. 1.

it does not require any watching, even throughout long series of observation.

The positive (central) electrode of the counter is connected to the grid of an ordinary 3-electrode valve giving an anode current of 20-30 ma. when the grid is free (Fig. 1). To improve the insulation of the grid, the lead-in wire is pulled out through a hole drilled in the side of the bakelite socket and fixed in a plug of ebonite or amber. The anode current of the valve is sent through the coil of an ordinary telephone call meter; the screw which determines the movement of the yoke is insulated and connected to the grid. The yoke is connected to the negative end of the filament. The voltage swing applied to the grid by an impulse from the counter may easily attain a value of 50 volts and under ordinary working conditions is 20-30 volts, which is sufficient to break the anode current of the valve.

When the whole is at rest, the potential of the grid is nearly the same as the negative end of the filament; the anode current has the corresponding value, and the yoke of the counting machine is attracted by the magnet. Upon the arrival of an impulse from the counter, the anode current is broken, and the yoke is released; as soon as the yoke touches the screw, the anode current is raised again to its normal value.

The connexion of the grid to the insulated screw is necessary; when the grid is brought to a negative potential of 20-30 volts and left to itself, it would remain at this potential for a considerable time, since no grid leak is used.

The number of impulses should generally not exceed 200 per minute; when the number is higher, a considerable number of impulses may be lost. This seems for the main part to arise from the counter itself, a certain restoring time being necessary after each impulse.

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Effect of Light on the Surface Tension of Boys's Soap Solution.

THE letter of Prof. L. D. Mahajan in NATURE of Sept. 19, p. 496, which brings forth an interesting point, may be slightly misleading, inasmuch as it tends to indicate that time, or rather adsorption as a function of time, is only a negligible factor in the decrease of the surface tension of colloidal solutions, which I pointed out in 1924.

Even before Dr. Mahajan's memoirs are published, I feel that I must remind the reader who is interested in these questions that the conditions of Dr. Mahajan's experiments are quite different from those on which I based my interpretation of the experimental facts, and that consequently it is premature to issue a general statement.

I have shown, indeed, that the 'time-drop' was small for high concentrations, such as 1 per cent, and that it increased as the dilution increased. For example, one sample would give a drop of 2 dynes at 1 per cent and 20 dynes at 1 per hundred thousand, or 10^{-5}. I explained the difference, and studied thereafter only high dilutions up to 10^{-7}, under subdued artificial light.

Now Dr. Mahajan states—without specifically limiting his statement to sodium oleate solutions—that "the decrease in surface tension is a function of the time for which the solution is exposed to light and not a mere function of the time". As the concentration of the *soap solution + glycerin* which he uses is not stated, but may be as high as 2·5 per cent—which should give a very small drop—it is indeed quite possible that illumination plays a part in this case. But this does not substantiate the general statement that even in the case of high dilutions, where the drop is considerable, "a possible reason for this is a chemical action, not adsorption in the surface layers alone".

I shall look forward with much interest to Dr. Mahajan's papers, but as some readers may not see them, I think it advisable to direct their attention to the fact that the experiments reported in his letter cannot suffice to weaken my former interpretation.

P. LECOMTE DU NOÜY.

Institut Pasteur, Paris,
Sept. 23.

Fine Structure in the Arc Spectra of Indium and Thallium.

Indium.—The hyperfine structures of a few indium arc lines have been reported by Jackson [1] and McLennan.[2] Jackson observed that each of the lines $1\,^2S_{\frac{1}{2}} - 2\,^2P_{\frac{1}{2}}$ and $1\,^2S_{\frac{1}{2}} - 2\,^2P_{\frac{3}{2}}$ is a quartet; while McLennan observed only three components. McLennan deduced a value $i = \frac{1}{2}$ for the nuclear moment, while Jackson, from intensity considerations and the structures of the lines, inferred $\frac{7}{2}$ as the more probable value of the nuclear spin.

The fine structure patterns are not generally completely resolved, owing to the lack of resolving power in the interferometer and owing to the effect of electric fields and pressures in broadening the spectral lines. The fine structure measurements of the lines 4511, 4101, 3259, and 3256 A. have recently been made by me, using a specially constructed vacuum arc of 2 per cent amalgam of mercury and indium with cathode and anode cooled. Owing to the extremely low partial pressure of indium vapour, the lines were found to be extremely sharp and without self-reversal in this source. The fine structure was examined by a quartz Lummer plate (200 × 30 × 8 mm.) and quartz and glass plate etalons. The photographs clearly show the complex structure found by Jackson. A careful examination of the fine structure and the intensity value of the components indicate that the most probable value of the nuclear movement is $\frac{5}{2}$ or $\frac{7}{2}$.

Thallium.—Fine structure measurements of arc and spark lines have been recently reported by Schuler [3] and McLennan.[4] The fine structure of the arc lines 5350, 3776, 3529, 3819, and 2768 A. has been examined by me by employing experimental arrangements similar to those for indium: 3776, 3524, and 3519 were observed in detail. The structure of 3776 was observed under different conditions of excitation, and it is found to have five components.

3776 and 2768 show more hyperfine structure components than required by theory for $i = \frac{1}{2}$, and there is evidence of a weak isotope with the same nuclear moment. The observations confirm the value $i = \frac{1}{2}$ for the nuclear moment suggested by Schuler and McLennan.

Full details of these fine structure measurements will appear shortly in this Observatory's bulletin.

A. L. NARAYAN.

Kodaikanal Observatory,
South India, Aug. 19.

[1] *Proc. Roy. Soc.*, **128**, 575; 1930.
[2] *Proc. Roy. Soc.*, **129**, 208; 1930.
[3] *Zeit. für Physik*, vol. 55, p. 575.
[4] *Proc. Roy. Soc.*, vol. 125, p. 570.

The Magneto-Electric Saturation Effect.

As is well known, all previous investigations performed in order to find a magneto-electric saturation effect have led to a negative result. This is of importance for the classical theory of Langevin as well as for the wave theory. It would therefore seem to be of importance to try to find this effect by the help of new methods. In this note we propose to give an outline of the main feature of our method and the results obtained. The theory and the observations will be published later.

According to the new theory of strong electrolytes given by Debye, we know that the electric field of the ions has a great influence, for example, on osmotic phenomena and electric conductivity. At a distance of the same order as the diameter of an ion a field of force is produced of the magnitude 10^6 volts/cm. Let us consider a solution of a strong electrolyte, for example, potassium chloride in water. This electrolyte is separated in K^+ and Cl^+ ions. Add to this solution neutral molecules which are carriers of electric dipole moments. Due to the field they will, for example, in the proximity of a K^+ ion, orient themselves in the direction of this ion; naturally in equilibrium with their thermal motions. Assume that these neutral molecules that have electric dipole moments also possess magnetic moments fixed to the molecules.

The conditions now being clearly stated, the following experiment will be understood. The apparent magnetic moment of molecules which possess fixed magnetic as well as electric moments must be decreased by adding to the solution a strong electrolyte. We have calculated the magnitude of this effect on the basis of the classical magnetic theory. Measurements of the magnetic susceptibility have been performed by aid of Quincke's method improved by Piccard.

The observations have been performed on a solution of $(Cr(NH_3)_3(CNS)_3)$ in acetone by adding KCNS as a strong electrolyte. The results are decidedly negative. The experiments therefore are in favour of the new wave theory of paramagnetism.

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Electric Circuit Breaker Research.

DURING the continuation in February, March, and August 1928 of tests commenced in 1926 by the Circuit Breaker Research Section of the British Electrical and Allied Industries Research Association, highly inductive power circuits of 6600 volts carrying more than 1000 amperes were successfully broken in oil, at gaps of from one-fifth to one-eighth of an inch, in an experimental circuit breaker of novel design. It was not found practicable to use smaller gaps, owing to the possibility of beads of copper forming, reducing the arc gap; thus it was not possible with the maximum voltage of 6600 volts then available to determine accurately the true dielectric strength per cm. at arc break.

Recently, through the courtesy of Dr. S. L. Pearce, of the London Power Co., Ltd., we have been able to carry our investigations up to 22 kv.

In these tests, which were carried out from Sept. 8 to Sept. 17, 1931, an arc current of 500 R.M.S. amperes was extinguished in an oil-immersed electrode gap, before the electrodes had separted half an inch (in a highly inductive circuit using power transformer stepping up from 6600 volts to 22,000 volts and giving a recovery voltage of 21,000 R.M.S. volts across the single arc gap in use). Seven repeat tests were made under the same conditions; the arc was in several cases extinguished before the separating electrodes had reached a gap of one-fifth inch, corresponding to a dielectric strength of over 100,000 volts per inch, gained within a few micro-seconds from the time when the arc current had reached a zero in its alternation.

As an indication of the advance made, it may be mentioned that an average figure for the dielectric strength at arc extinction in plain break oil circuit breakers is of the order of 2500 volts per inch at similar currents.

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London, W.C.2, Sept. 28.

Research Items.

An Alleged Moose-Wapiti Hybrid in Montana.—*California Fish and Game* (vol. 17, p. 198; 1931) contains a reference to what is said to be the first known specimen of a 'moose-elk', or in our nomenclature a 'moose-wapiti', hybrid. Known to the United States forest rangers as "the elk with the funny horns", this curious cross was recently killed in the Deerlodge National Forest, Montana. The rangers had for the past five years known of the animal, which associated and grazed with the wapiti, but the horns and the body of which were half moose and half wapiti. When first seen in 1925 he appeared to be about a three-year-old, and his weight when slain was 1100 pounds. Our impression is that so rare and odd a hybrid deserved a much more detailed obituary notice, since experience shows that there is often the possibility of an abnormal member of one species being regarded as a cross with another.

Bird Migration in Switzerland.—An important contribution to the migratory movements of birds in Switzerland, founded upon field-observation and ringing, and summarising in all 16,500 data for the spring movements and 5600 for the autumn, is made by Dr. Konrad Bretscher (*Mém. Soc. Helvét. Sc. Nat.*, vol. 66, mem. 2, 1931). The data cover long periods and refer to sixty-eight species in spring and forty-nine in autumn. There is general agreement between the information gained from the two methods of observation, and the results indicate that the main migratory route lies through the Great Valley between the Alps and the Jura mountains. In spring the journeys run from south-west to north-east, and in autumn take the reverse direction. A second important route lies over the northern Jura, in spring in an eastern, in autumn in a western direction. The northern Alpine valleys are peopled by side movements from the Great Valley, whereas the southern valleys receive their birds from the south, so that both sides of the mountain chain contribute to a cross-migration, in which it is impossible to separate the elements. Further researches, especially by the ringing method, must be made before an understanding can be reached of the movements in the Alps, particularly in the Wallis and Engadine districts.

Weevils of Samoa.—Part 4, Coleoptera, Fascicle 5, of "Insects of Samoa" in course of publication by the British Museum (Natural History), is concerned with the Curculionidæ or weevils of those Islands. Sir Guy Marshall, who is the author of the present contribution, remarks that ten years ago only 22 species of these insects, comprised in 15 genera, were recorded. He is able now, as the result of his studies, to raise these numbers to 86 species belonging to 55 genera, of which 54 species and 15 genera are described for the first time. Only eight of these species are known to occur outside the Pacific islands, and of the remaining 78 species, no less than 80 per cent must, at present, be regarded as being peculiar to Samoa. A study of the different genera of these insects appears to suggest that the Samoan fauna has been derived from the Malay Archipelago by way of New Guinea and not from the south. Since too little is known of the insects of Tonga and Tahiti, it cannot be determined how far they are related to those of Samoa. All that can be said is that the insects of the last-mentioned islands show, on present indications, most affinities with those of Fiji. Sir Guy Marshall's memoir, it may be added, is a noteworthy contribution to a knowledge of the family Curculionidæ, and is admirably illustrated by figures drawn by Mr. A. J. Engel Terzi.

Industrial Shells of the Philippines.—F. Talavera and L. A. Faustino (*Philippine Jour. Sci.*, vol. 45, No. 3; 1931) report on the shells gathered on a commercial scale in the Philippines. The gold-lip pearl shell (*Pinctada maxima*) is utilised primarily in the manufacture of buttons, but other objects, such as knife handles, are made from this shell. Preliminary experiments on culture pearls in 1929 were encouraging; shell-beads 5 mm. in diameter introduced into two-year old 'oysters' had increased at the end of thirteen months to 7 mm. The black-lip pearl shell (*P. margaritifera*) is more widely distributed. The shell, which reaches a diameter of 9 cm., is used for the making of buttons, of inlaid work, cameos, etc. The majority of the *Trochus* shells collected are of *T. niloticus*, and are found chiefly on the islands near the outer edge of the coral reefs. Closely associated with the last species is the green turban shell (*Turbo marmoratus*). Both are used in making buttons and other objects. The window shell (*Placuna placenta*) supports an industry of considerable importance. Although usually found in the littoral zone this species is known to live in water 40 metres deep; it flourishes in mud or sand-mud bottoms in shallow bays and in estuaries. Fishermen in certain regions transplant undersized examples to better grounds. The shell, which reaches a diameter of 55-77 mm. at the end of the first year of growth and about 133 mm. at the end of the second year, is used instead of glass for window panes, shades, etc. The pearly nautilus (*N. pompilius*) is taken in deep sea bamboo traps set to capture bottom fish, and its shell is being used in the manufacture of lamp-shades, spoons, etc.

Life-Cycle of *Moniezia expansa*.—D. F. Sinitsin (*Jour. Parasit.*, **17**, June 1931) records observations on the egg of the cestode *Moniezia expansa*. The adult tapeworm lives in the small intestine of sheep, and ripe segments containing the eggs are passed with the excrement. The author describes the three envelopes of the egg, which contains a capsule composed of a spherical body and two tapering horns. In the body of the capsule is the six-hooked embryo and an apparatus for feeding the horns. Experiments extending over forty-five days, during which the eggs were repeatedly dried, showed that the shell provides very efficient protection against desiccation, and the author concludes that under normal conditions in Nature the egg does not reach its prospective host at once, but is destined to be at large rather a long time. In the later period of the experiment the egg shell became very fragile; the slightest touch broke it and freed the capsule with its horns, one of which is twisted round the other at this time. If the horns come in contact with a moist surface they untwist and form a boring apparatus. The mucus of the trachea brings about this boring action, and causes the solution of the capsule in less than thirty minutes. The author concludes that an intermediate host is lacking in the life cycle of *Moniezia expansa*. "The embryo, after a period of about two months' development in moist materials, returns again to the sheep by the air. Perhaps it enters the capillaries of the windpipe or alveoli, and, by the aid of the circulatory system, eventually reaches the intestine."

Mutable Genes in Delphinium.—Two mutable genes in *Delphinium* are the subject of a paper by Demerec (*Jour. of Genetics*, vol. 24, No. 2). The rose-alpha gene is unstable, reverting to the wild purple type of cell both in the sepals and petals (causing purple spots) and in the germ cells. By measuring the sizes of the spots and estimating the number of cell

divisions involved, the frequency of the somatic mutations could be estimated. It was found that it was of the order of 267 per million cells both in gametogenesis and in the sepals. This rate was relatively constant in successive cell generations in different parts of the plant through four sexual generations. The lavender-alpha gene also mutates to purple, so that lavender-variegated plants give offspring which may be lavender-variegated, purple, and purple-lavender chimæras. This gene shows a high rate of mutability in early stages of development of the plant (since half the non-purple plants from seed are chimæras), relative stability in the early stages of sepal and petal development, and high mutability towards its end. The author concludes that these phenomena of variegation are not due to the gene being compound and composed of parts which segregate, but to a mutation which tends to occur in the particular gene at the time when it splits in mitosis.

Earthquakes and Mineral Springs.—The effect of earthquakes on mineral springs has often been noted. Mr. B. M. Radoslavoff traces the relations in Bulgaria as the result of the earthquake of 1928, in *Matériaux pour l'Étude des Calamités*, No. 25, 1931. The thermal springs are all in the neighbourhood of volcanic formations. Some springs dried up and several new ones appeared. The Meritchleri spring was replaced by exhalations of carbon dioxide. The Kovanlak springs ceased for three weeks and then began to reflow. Most of the well-known springs show an increased flow, in some cases as much as 200 per cent. The temperature of the different springs has, on the whole, remained unchanged, while in previous Bulgarian earthquakes the tendency seems to have been for temperatures to increase.

Soil Classification.—The possibilities of an international system for the classification of soils have recently been examined by L. L. Lee, of Rutgers University, the thesis appearing in the *Journal of South-Eastern Agricultural College*, Wye, Kent, 1931, with an extensive bibliography appended. The New Jersey system of classification is discussed at length, and the soils of the New Jersey (U.S.A.) area and of south-eastern England have been classified according to this system, enabling comparisons to be made. In both areas the soils occur in belted zones closely related to the geological formations, and in both cases also a direct relationship exists between the geological formation and climate and the distribution of the soil series, the number of soil classes being greater in central New Jersey. Podsolisation in general is further advanced in the soils of the American areas than is the case in south-eastern England. In both areas the importance of the parent geological materials is such that any system of classification applicable to both regions must be one in which geological factors are dominant, and it is suggested that the New Jersey system based on this foundation might find satisfactory application elsewhere in the British Empire and western Europe. Sandy profiles predominate in New Jersey, and heavy profiles, containing high percentages of silts and clays, in Kent, a direct relation existing between the texture of the soil profile and the geological formation in each district. Climate and soil reaction are also associated. No alkaline soils occur in the American area, whereas they are quite common in south-eastern England, climatic factors having altered the soil reaction more in the former than in the latter case.

A Photoelectric Relay.—The issue of the *Physikalische Zeitschrift* for Sept. 1 contains a note by Dr. L. Bergmann, of the University of Breslau, describing the arrangement he has devised for measuring small movements such as those of a galvanometer mirror by means of a relay depending on the sensitive selenium cell he described in the issue of the *Zeitschrift* for April 1. The cell consists of a thin layer of selenium in its conducting state, on an iron surface and covered by a semi-transparent film of gold or silver, deposited by cathode spluttering. In the relay a square of the cell of 1·5 cm. side is partially exposed, through a grating of ten parallel opaque strips, to light reflected from the mirror, the movement of which is to be measured. The incident beam forms on the grating an image of a similar grating, in such a way that a narrow strip of cell on one side of each strip of grating is illuminated, and motion of the mirror alters the width of this strip. The deflection of the galvanometer mirror in the cell circuit has by this arrangement been increased to 5000 times that of the mirror from which the reflection takes place.

Negative Ions.—Prof. H. D. Smyth has contributed an article to the July number of *Reviews of Modern Physics* upon the products and processes of ionisation by slow speed electrons. The principle of all the methods which have been employed is much the same; the gas is subject to a controlled source of ionisation, usually electrons, and the products are examined by one of the standard methods of magnetic analysis, or by the more recent electrostatic methods. Perhaps the most remarkable fact which emerges from this report is the scanty knowledge which we possess of the properties of negative ions. With a few exceptions, the usual statement which is made about any particular gas is that negative ions have been observed, but that practically nothing is known about the conditions governing their formation. Even in the case of the strongly electronegative substance iodine there is much uncertainty. I^-, I_2^-, and I_3^- occur in quantities comparable with those of the positive ions, but it is apparently as yet undecided what part is played by primary processes and what part by secondary processes in their formation. Perhaps the most significant observation is that to produce negative hydrogen atom ions by electron bombardment in water vapour, the electron energy has to be very closely either 6·6 volts or 8·8 volts; a similar law of formation is known for certain excited states of atoms, but is not found with positive ions.

Electrokinetics and the Interpretation of Surface Conductivity.—McBain and Du Bois, in the *Zeitschrift für Elektrochemie*, vol. 37, p. 651, point out that Helmholtz's theory of electroendosmose as due to the motion of the inner portion of the double layer should be replaced by the explanation put forward by McBain in 1924 and confirmed by experiments of Laing and others. The ions, water, and wall of the tube are all in motion relative to one another; the double layer is seldom complete, and the greater part of it plays no part in electrokinetics. All ions, walls, colloid particles, gels, diaphragms, etc., according to Laing, take part in the transport of current in the proportion of their actual conductivities, so that if μ is the total conductivity, the ion transport is of the form $c'u'/\mu$, where c = conductivity and u = mobility; and the wall, colloid, etc., transport is of the form $c_1 m_1 f_1/\mu$, where m_1 is the number of chemical equivalents carrying a faraday of charge and f the mobility. The formula of Smoluchowski has been disproved by experiments of McBain and Peaker on the increase in conductivity of solutions in contact with optically polished glass or quartz, and stearic acid on water: the results would give impossible values of the thickness of the electrical double layer. The classical formulæ of electrokinetics appear to be quite incorrect.

The British Heavy Steel Industry.

THE present position of the British heavy steel industry was reviewed by Prof. H. Stanley Jevons in a paper read on Sept. 30 to Section F (Economic Science and Statistics) of the British Association during the centenary meeting in London. Prof. Jevons said that the heavy steel industry is probably the weakest part of our industrial fabric at the present time, though it presents the greatest possibilities for development among the older British industries. The present depression is largely due to the effects of the War, as it has led to a 50 per cent increase in steel-making capacity, but the new plants erected during the War were erected at high costs and were not located or planned to the best advantage for peace-time operation. Since the War, production has remained stationary, and more recently has actually fallen off. Exports also have declined, but imports have increased somewhat. We are now surpassed by Germany as a steel-exporting country. Britain, however, is still pre-eminent in the production of high quality steels, and in this section of the industry Sheffield still leads the way. It is characteristic of the British steel industry, as of the other older British industries, that quality has been put first and low cost of production made entirely secondary.

German steelworks generally secure a larger output per hour with lower fuel consumption per ton, while their superior mechanical equipment reduces their costs of handling materials below those in British works. In Britain the cost of pig-iron is high, mainly on account of the small size of our furnaces. Wages also are somewhat higher than the rates paid in Germany and much higher than those in France and Belgium. This disparity might be counteracted by means of better equipment or improved business organisation, but so far this has not been achieved. The price policy adopted by the majority of firms in the British iron and steel industry is probably responsible for the high rate of unemployment, which has now risen to 43 per cent of those engaged in the industry. Even allowing for rebates given by British steel producers to contractors who regularly use British steel, imported steel is much cheaper than that produced at home. Thus, Belgian steel joists delivered in the Birmingham district are £4 6*s*. per ton and billets £3 16*s*., as against British prices of £8 and £5 per ton respectively. Prof. Jevons doubts if the rebate scheme is, on the whole, well advised, because it tends to limit the number of contractors employing British steel to those who agreed to the conditions of the rebate.

Among the various remedies which have been proposed as a cure for the post-War depression in the industry, the most prominent is the demand for a safeguarding duty. Foreign competition and severe unemployment in the industry can be advanced as arguments in favour of this policy, but, on the other hand, it might happen that a protective duty would merely bolster up inefficiency and might retard a necessary reorganisation of the industry. If a tariff is imposed, it will therefore be necessary to ensure that the industry will not raise home prices, but will only seek to work plants up to their capacity.

A committee appointed by the Government to investigate the condition of the industry recommended reorganisation on a regional basis, whereby heavy steel production would be concentrated in four districts. The committee considered that ten million pounds would be required to modernise existing plant. The Iron and Steel Trades Confederation—a trade union organisation—following to some extent the lead of this committee, proposed that a public utility corporation should be set up for the purpose of reorganisation on a regional basis.

Prof. Jevons pointed out that Britain was the first country to develop a great iron and steel industry, and, as compared with her competitors, she has still many valuable natural advantages, such as an abundant supply of coal. Moreover, these islands are peculiarly well situated for the export trade to all parts of the world. It is reasonable to expect a considerable growth in the demand for steel during the next twenty years if prices can be reduced, since steel is an essential requirement nowadays in the building industry, mining, railway wagon and carriage construction, and in many other industries. There is also a large potential export market in our colonies and undeveloped tropical dependencies.

Prof. Jevons recommends that the whole heavy steel industry in Britain should be replanned and rebuilt on a national scale with plants larger than any yet constructed in Europe. New plants of the latest type would have to be erected in South Wales, on the Clyde, on the north-east coast, and near Liverpool or London, with the view of facilitating the export trade. The industry should set itself to raise the annual production of steel from the present figure of about nine million tons and exports of four million tons to a total production of twenty-five million tons per annum, of which about ten million tons should be regarded as for export. This extension of the industry, though at first sight it might seem to be too ambitious a project, would make it no larger than the present size of the United States Steel Corporation. Prof. Jevons admits that the establishment of such an extensive reorganisation would require to be financed by the State, or at least interest on the capital would have to be guaranteed by the Government, but it is in the public interest to use the credit of the State in some manner to re-establish and enlarge the industry.

Applied Chemistry in Technical Colleges.

THE Board of Education has recently issued a report, prepared by H.M. Inspectors,* on the provision of instruction in applied chemistry in technical schools and colleges (except junior technical schools) in England and Wales which are in receipt of grants from the Board. It does not deal with instruction in universities. The survey has not been extended in an attempt to cover questions of provision and requirement wherever chemists are employed; the term 'applied chemistry' has been limited to the chief branches of chemical industry, which for this purpose is regarded as an industry in which raw material changes its composition as it passes through the works.

A table shows that more than 5500 students attended these courses; but the significance of the statistical information does not lie in the number of individuals receiving the instruction. A fact of greater importance is the wide adoption of the provision of well-balanced curricula instead of instruction in single and unrelated

* Board of Education, Educational Pamphlets, No. 85 (Industry Series, No. 10): Report by H.M. Inspectors on the Provision of Instruction in Chemistry in Technical Schools and Colleges in England and Wales. Pp. 55. (London: H.M. Stationery Office.) 1*s*. net.

subjects. Many of the students who are not following such grouped courses are doing work of an advanced and sometimes post-graduate standard. Less than twenty per cent of the total number of students are receiving elementary instruction in single subjects, and a considerable proportion of these are attending lectures of a non-professional type and standard.

The report describes the general character and distribution of the facilities offered for the study in these institutions of applied chemistry, the information being grouped under the headings: fuel industries; chemical engineering and chemical technology; metallurgy; pottery and refractories; bleaching and dyeing; leather manufacture, rubber technology, and paper-making; foods and drugs; oils, fats, and waxes; painters' colours and varnishes; coal tar colours; synthetic resins and cellulose industries. While the tendency to defer the teaching of applied chemistry until an adequate knowledge of pure chemistry and ancillary subjects has been obtained is commended, it is stated that beyond the elementary stage the instruction provided in physics is rarely what is required—it is either too narrow or too wide. On the other hand, a few schools seek to meet the needs of a small number of students of varied requirements by offering lectures in certain subjects which all attend, the main differentiation being achieved by individual instruction in the laboratory. The wisdom of attempting such an "almost impossible task" is, however, doubted.

The attitude of employers has entered on a new phase, passing from individual benevolence to a clearly defined collective policy, and being associated with a closer interest, so that the training "is tending to become a definite element of industrial organisation". The position which has now arisen is that expanding knowledge renders necessary a higher standard of training, which can be given more satisfactorily and under less onerous conditions in part-time day courses than in classes held exclusively in the evenings. While the difficulty of interrupting routine work by releasing employees for this purpose is acknowledged, the wide adoption of such a plan by the engineering industry and other industries is quoted as an example which might with advantage be copied more frequently in applied chemistry. Not only is co-operation in the use of facilities desirable, but also the achievement of completely co-ordinated schemes of technical education is a matter which requires closer co-operation between educational administration and industry.

A relatively new problem is the provision of instruction suitable for men, engaged on plant or process, who control apparatus or machinery without sharing the chemist's responsibility or ambitions. The well-informed worker finds greater interest in his work, and renders more efficient service to his employer; but "the traditional method of approach is not likely to be successful. A new technique in teaching is required." Another type of instruction which seems desirable is the commercial training of men who are primarily chemists or technicians.

A Monument to Henri Moissan.

HENRI MOISSAN was born in Paris on Sept. 28, 1852, and died there, at the age of fifty-four, on Feb. 20, 1907. He is remembered to-day for his successful work on the isolation of fluorine, his experiments on the manufacture of artificial diamonds and the development of the electric furnace.

Moissan's isolation of fluorine in 1886 was accomplished by electrolysing a solution of potassium hydrogen fluoride in anhydrous hydrofluoric acid contained in a platinum tube. He was led to his researches on diamonds by the study of the allotropic modifications of carbon, and the minute diamonds he made were obtained by melting iron and carbon in a crucible and dropping the fused mass into water. The electric furnace which he used in these experiments consisted of a scooped-out block of marble, covered by a marble lid having two horizontal passages for the carbon electrodes, the current being obtained from a small dynamo.

Moissan's whole life was passed in Paris. He entered the laboratory of Fremy at the Muséum national d'Histoire naturelle at the age of twenty; at thirty-four he was appointed professor of toxicology in the École Supérieure de Pharmacie, in 1899 was transferred to the chair of mineral chemistry, and the following year became professor of general chemistry at the Sorbonne. Elected a member of the Paris Academy of Sciences in 1891, he was made a foreign member of the Royal Society and awarded the Davy Medal, and in 1906 received the Nobel Prize for chemistry. His son, Louis Moissan, an assistant at the École Supérieure de Pharmacie, who was killed in action on Aug. 10, 1914, left funds for founding prizes in memory of both his father and mother.

A fête in honour of Moissan was celebrated on Oct. 4, in brilliant autumn sunshine, in the cathedral town of Meaux, picturesquely situated on the banks of the Marne. The delegates were received on Saturday afternoon, Oct. 3, at the Ministry of Foreign Affairs on the Quai d'Orsay, and on the following morning nearly three hundred were taken by special train to Meaux to take part in the ceremonies there.

These ceremonies included the formal presentation to the Communal College (of which Moissan was a pupil from 1864 until 1870) of a plaque on the wall of the entrance hall, and in the afternoon the unveiling, by Mme. Jean Gerard, of a monument in a small square by the side of the town hall. The monument is in the form of an obelisk, from the upper part of which the rugged features of Moissan emerge from the solid stone, whilst on the side are sculptured diagrammatic representations of his electric furnace and of the apparatus with the help of which he isolated fluorine, with quotations from his own writings.

Discourses appropriate to the occasion were delivered, in a natural theatre formed by the surrounding buildings and gardens, under the direction of Prof. Behal, representing the Minister of Public Instruction. The first three discourses were by the president of the organising committee, by the mayor of Meaux, and by the president of the old students' association of the College of Meaux; the others were by M. Lebeau, the assistant and colleague of Moissan, representing the friends and students who had worked in Moissan's laboratory, by Prof. Hönigschmid of Munich (himself an old student of Moissan) on behalf of the foreign delegates, and by Prof. Behal on behalf of the Government. Prof. Behal was supported by the presence, also in full dress, of his fellow academicians, Bertrand and Délépine, and by many of their French colleagues.

The list of foreign delegates included sixty-three names, but of those actually present the three representatives from Great Britain constituted as large a group as from any other country except Belgium and Italy. The ceremonies were associated with the eleventh meeting of the Société de Chimie industrielle, and owed much of their success to its vice-president, M. Jean Gerard, who has been responsible for the organisation of so many international gatherings.

Universal Decimal Classification.

THE fifth report of the International Committee on the Decimal Classification was presented by F. Donker Duyvis to the Tenth Conference of the Institut international de Bibliographie at the Hague on Aug. 25–29, and indicates the growing value and increasing use of the Universal Decimal Classification in the interchange of technical and scientific information. A translation of the chapter on electrotechnics has now appeared in Germany, and an extensive abridged manual of the classification is in preparation under the leadership of Dr. Günther. Further translations and expansions in progress in Germany were reported on by Herr C. Walther, the main interest being directed to the technical sciences, whereas in Great Britain progress has been mainly with the pure sciences, medical sciences, and agriculture. This lack of progress, as indicated by Mr. B. M. Headicar in a paper describing the construction of the "London Bibliography of the Social Sciences", is largely due to the absence of an English translation. Nevertheless, in meteorology, plant genetics, agriculture, and general biology, progress has been made, and Dr. J. G. Priestley in reviewing the position of bibliography in physiology indicated the value of the decimal system in constructing the complete card index of physiological and allied subjects which is a fundamental need. As a first step, *Physiological Abstracts* has already commenced to reprint decimal numbers from original papers in which they are used.

Many of the papers presented at the Conference afforded further evidence of the wide use of the decimal classification and the efforts being made to improve and extend the system by international co-operation. Its value in the organisation and documentation required for the *Révue générale de l'Électricité* was described by E. Beinet. O. Frank and C. Walther reviewed German developments in further detail, in which country it has been adopted by the German National Committee for the power and fuel bulletin initiated by the World Power Conference, and important libraries such as those of the Technical High School, Aachen, the I. G. Farbenindustrie A.-G, Leverkusen, the Central Technical Library, Frankfurt, the German Industrial Safety Museum, Berlin, the German Patent Office, and the Berufsgenossenschaft der Chemische Industrie, etc., while a full account of its use by the A.G. vormals Skodawerke in Pilsen was contributed by F. Kondelak.

In a report on "Documentation in Medicine" presented by Dr. Rene Sand, secretary of the League of Red Cross Societies, adoption of the decimal classification as a means of expediting the much-needed international co-operation in the organisation of documentation and bibliography in medicine was strongly urged, and the application of the decimal classification in the aluminium industry was discussed in a report presented by the S. A. pour l'Industrie de l'Aluminium à Neuheusen. A paper by J. Cenek described its use in industry in Czechoslovakia, and difficulties encountered by Polish engineers in adopting the system were described in a further paper from the Bibliographical Section of the Society of Polish Technicians, Varsovie. Other papers dealing with the decimal classification included J. Gevers' review of thirty years' experience with the system in the Belgian Patent Office, the application of the decimal system in local administration and social problems, and in public administration archives (L. Wouters), while G. A. A. de Voogd, chief of the Organisation Department of Bataafsche Petroleum Maatschappig, in a paper on rationalisation in documentary administration, described the extension of the decimal classification to meet the stringent demands of scientific management in the head office of a world-wide organisation.

Other papers presented at the Conference included one by Dr. M. Pflücke, principal editor of the *Chemisches Zentralblatt*, describing the organisation of abstracting and indexing of the *Chemisches Zentralblatt*, co-operation between libraries (J. W. Pafford), the standardisation of sizes (Frank), the use of addressographing machines with the decimal classification (W. Schümeyer), and international abstracting and indexing of scientific literature (Sir Frederic Nathan), and reports on the progress of the *Reportorium Technicum*, the *Index Bibliographicus*, and the Commission on Cataloguing Rules.

The Behaviour of Electrolytes in Solution.

A DISCUSSION on the influence of the medium on the properties of electrolytes initiated by Sir Harold Hartley on Sept. 24, in Section B (Chemistry) of the British Association during its centenary meeting in London, gained further interest from the presence of several distinguished foreign men of science whose investigations have largely contributed to recent developments in this field. Striking success has attended the application to dilute solutions of the Bjerrum hypothesis of complete ionisation. With the Debye treatment of the interionic forces, this has induced the extended study of other solvents with the object of testing the validity of the theory.

In the discussion, Prof. P. Debye described the results of experiments to determine the effect of alterations in frequency on the electrical conductivity of solutions in different solvents. This effect is due to the finite time (of the order of 10^{-7} sec.) which is required for the formation of an ionic atmosphere round an ion, and at very high frequencies or in very viscous media marked increases in conductivity can be obtained. For example, with a solution of calcium ferrocyanide in a mixture of 96 per cent glycerol and 4 per cent water, the conductivity is increased 500 per cent when a frequency of 10^4 cycles is employed. No values are obtained for the equivalent conductivity which are greater than the limiting value for infinite dilution, and this, according to Prof. Debye, implies that interionic forces are mainly operative.

Profs. N. J. Bjerrum and J. N. Brönsted discussed the solubilities of salts in different solvents and the agreement between experimental data and calculations based on Born's formula. Prof. Bjerrum, dealing with the forces between ions and solvent molecules in relation to the solubility of electrolytes, considers that the agreement is as good as can be expected on the basic assumptions made.

Evidence of the existence of strong specific forces between the ions and the solvent molecules was advanced by Sir Harold Hartley from the conductivity of salts in different solvents and by Prof. J. C. Philip from a comparative study of the nitriles as solvents. While in water and to a lesser degree in the alcohols simple univalent salts conform fairly closely with the requirements of the Debye-Onsager equation, in non-hydroxylic solvents, for example, acetone, nitrometh-

ane, and the nitriles, there are marked divergencies, which can most readily be interpreted by the assumption that the ions carry with them sheaths of solvent molecules. Dr. J. A. V. Butler has reached a similar conclusion from a study of the behaviour of electrolytes in mixed solvents, for example, alcohol-water mixtures, and showed that by the comparison of different properties conclusions can be drawn as to the nature of the molecules in contact with the ions. Dr. E. A. Guggenheim showed that this experimental evidence of ionic solvation is in agreement with theoretical requirements. Thus the dissociation constant of sodium chloride calculated by the methods of statistical mechanics is too small to account for the apparently complete dissociation of the salt in solution. If, however, hydration of the ions be postulated, a plausible value is obtained for the dissociation constant.

University and Educational Intelligence.

Oxford.—In his speech on the conclusion of his second year of office, the vice-chancellor (Dr. Homes Dudden, Master of Pembroke) explained why no election has yet been made to the vacant Savilian chair of astronomy. This, he said, is due to the fact that the whole problem of the future of astronomy in Oxford has been under review. A detailed scheme has now been prepared, which includes the construction of a new and thoroughly equipped observatory on a suitable site near Oxford; the representation of both positional astronomy and astrophysics on the professional staff; and an extension of facilities, in close connexion with the new observatory, for the teaching and study of meteorology and geophysics. The completion of the scheme is waiting for the provision of the necessary funds.

The University of Berne has conferred doctorates *honoris causa* on Sir Charles Sherrington, Waynflete professor of physiology in the University of Oxford, and Prof. Harvey Cushing, professor of surgery in Harvard University.

A special course of lectures on "Some Applications of Biochemistry to Modern Pharmaceutical Problems" will be given by Messrs. Frank Wokes and F. J. Dyer, in the Lecture Theatre of the Pharmaceutical Society of Great Britain, 17 Bloomsbury Square, on Oct. 22 and succeeding Thursdays, at 5.30 p.m. Admission to the first lecture is free without ticket. The subject will be "Physical and Chemical Conditions Necessary for Life".

The council of University College, Southampton, has appointed to the chair of engineering Wing Commander T. R. Cave-Browne-Cave, who was responsible for the machinery installation of the *R101*. Mr. H. Leech, who, with Wing Commander Cave, made every trial flight in the *R101*, and was lately foreman of the Engine Department at the Royal Airship Works, has been appointed experimental engineer.

Education in India cost in 1929, the latest year for which statistics have been published, 270 million rupees, of which nearly two-thirds was provided by government and local authorities. This expenditure has been frequently criticised, on the ground that it maintains a system of education appropriate enough for the small minority of pupils destined for employment in government and private offices and the learned professions, but quite unsuitable for the needs of the general population, which is mainly rural. In a pamphlet entitled "The Indian Education Problem: a Solution", Mr. J. C. Ghosh, principal of the School of Chemical Technology, Calcutta, sketches an alternative system designed to divert a due proportion of educational effort into channels tending to improvement of agricultural and manufacturing industries and the public health. In the forefront of his suggestions is a plan for rural education on practical lines by teachers who would be maintained by the well-to-do villagers in rotation, "according to traditional custom and hospitality". In urban areas, boys and girls would start their education at home in conjunction with manual labour "in ancestral or family occupation", municipal and other free primary schools being maintained only for the children of parents too poor to undertake this home training. All pupils up to fourteen years of age would be scouts, and their efficiency in scouting, literacy, manual and physical training would be tested in camps of exercise, the existing expensive system of formal inspections being abolished. Literary education in secondary schools and universities would be ordinarily restricted to the rich and to exceptionally gifted boys and girls.

Birthdays and Research Centres.

Oct. 20, 1862.—Prof. Thomas H. Bryce, F.R.S., regius professor of anatomy in the University of Glasgow.

The chief investigations in progress in my laboratory are: first, it is impossible in some cases to reach decisive interpretations—by ordinary methods of investigation—of the appearances seen in serial sections of the free mammalian blastocyst just before implantation. A special technique is therefore being developed by Dr. Maclaren for the observation of the living blastocyst and for recording the results. Some success has already been obtained. Second, it was discovered by Dr. Nicol that in the intravitam staining of the tissues by trypan blue, the uterine mucosa (in *Cavia*) at certain stages was densely stained, due to the accumulation of certain cells packed with blue granules. This has been followed up, suggestive results are being obtained, and an interesting line of research is opened.

Oct. 20, 1891.—Dr. James Chadwick, F.R.S., fellow of Gonville and Caius College, and assistant director of radioactive research, Cavendish Laboratory, Cambridge.

I am studying, with the help of collaborators, the effects of bombarding elements by α-particles, in particular, the emission of protons and γ-radiations from the atomic nuclei and the scattering of the α-particles. The wave mechanics has given a clearer view of these problems, and the application of new experimental methods is giving new and detailed information. I hope that in a short time we shall be able to describe completely the interaction between an α-particle and an atomic nucleus, and have a reasonable picture of the structure of the nuclei of some elements.

Oct. 22, 1876.—Prof. Harold Hilton, professor of mathematics, Bedford College, University of London.

At the request of the Clarendon Press, I have been engaged lately in the preparation of a second edition of my book on "Plane Algebraic Curves". Time not absorbed by this task and the duties of my professorial work is mainly devoted to the study of problems in affine and projective differential geometry.

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 24.—**Georges Giraud**: Extension of the notion of principal elementary solution and applications.—**G. Nadjakoff**: The capacity of the quadrant electrometer.—**Adolfo T. Williams**: Ultimate lines and absorption lines. Absorption lines are not all ultimate lines, and very few of the latter are absorption lines.—**Norbert Casteret**: The communication of the Trou du Toro with the Goueils de Jouéou, the source of the Garonne. The Trou du Toro and the Goueils de Jouéou communicate. The underground flow, as shown by fluorescin used in large amounts, is very rapid, 400 metres per hour. The negative results obtained by E. Belloc in 1896–1900 were due to the fact that the dye was added in insufficient quantities.—**J. Bougault** and **G. Schuster**: The composition of karité butter. By the application of Hilditch's method of oxidation by potassium permanganate in alkaline solution, it was shown that karité butter contains 7·3 per cent of saturated glycerides, the unsaturated glycerides representing 92·7 per cent.—**Maurice Nicloux**: The combustion of alcohol by the pœcilotherm: the value of the temperature quotient. An account of experiments on the combustion of alcohol in the frog at temperatures ranging between 1° C. and 29° C. Within these temperature limits the quantity of alcohol burnt in 24 hours varied from 14 to 97 per cent of the amount injected. The temperature quotient of the biochemical reaction equals 2.—**Georges Bourguignon**: The technique of the measurement of large chronaxies, 0·3 to 1·5 sec.—**J. E. Abelous** and **R. Argaud**: The formation of adrenaline in the suprarenal gland. It is generally held that adrenaline is formed exclusively in the medullary substance; the small amounts found in the cortical substance have been regarded as due either to post-mortem diffusion or to the presence of stray islands of medullary substance. The author's experiments contradict this view, and show that the elaboration of adrenaline takes place in the cortical substance.—**Léon Velluz**: The antitoxic properties of certain diphenols and their mode of action.—**Georges Blanc** and **J. Caminopetros**: The sensibility of the spermophil (*Citillus citillus*) to the virus of exanthematic fever.

Aug. 31.—The president announced the death of Jean Effront, *correspondant* for the section of rural economy.—**H. Douvillé**: A curious meteorological phenomenon. A description of a form of globular lightning producing mechanical effects but showing no sign of electrical action.—**E. Bataillon** and **Tchou Su**: Activation, the elimination of a polar globule, and polyvoltinism in the *Bombyx* of the mulberry tree.—**Paul Delens**: The projective geometry of congruences of curves.—**E. Kogbetliantz**: The series of Hermite and of Laguerre.—**G. Kolossoff**: An application of the formulæ of Schwarz, Villat, and Dini to a plane problem of elasticity.—**Tournayre**: The calculation of secondary ribs in reinforced concrete.—**Ch. Bertin**: The determination of the point by radiogoniometry.—**J. Fallou**: The transmission of polyphase high frequency currents along cables for the transport of energy and the selective protection of electric networks.—**L. Hackspill** and **R. Lauffenburger**: The action of heat on the alkaline diacid phosphates. The salts studied ($NaH_2(PO_4)2H_2O$, $Na_2H_2P_2O_7 . 6H_2O$, $LiH_2(PO_4)$, $KHPO_4$, $K_2H_2P_2O_7$) lose water of crystallisation in a vacuum at well defined temperatures. The dehydration of ortho into metaphosphate generally takes place with intermediate formation of pyrophosphate, and in certain cases through tetraphosphate.—**André Meyer** and **Robert Vittenet**: The homophthalimides substituted in the nitrogen by aromatic radicals.—**Louis Bounoure**: The existence of a germinal determinant in the undivided egg of the russet frog.—**C. Levaditi** and **P. Lépine**: The study of 45 elements from the point of view of their curative properties in spirilloses, syphilis, and the trypanosomiases. Only 10 of the 45 elements studied have therapeutic properties as regards such diseases.

CAPE TOWN.

Royal Society of South Africa, July 15.—**W. Pugh**: The influence of fluoride ions upon the reduction of potassium permanganate. (1) Reduction with antimonious salts. In an attempt to overcome the difficulty of the fading of the end point in the estimation of antimony by the permanganate method, the effect of potassium fluoride was investigated. The consumption of permanganate increased by 25 per cent, and the solutions developed colours characteristic of manganic ion. The end point was, however, sharply distinguishable.—**P. R. v. d. R. Copeman** and **F. J. Dillman**: Decomposition of guano. During storage in an air-dry condition there is a loss of total nitrogen due to the loss of ammonia from guano. In a moist condition the uric acid in guano becomes converted into ammonium compounds and on subsequent drying there is an increased loss of nitrogen.—**A. C. Leeman**: The antimony electrode as a means for *p*H measurements. The antimony electrode was tested on various buffers and soil solutions under controllable temperature conditions. It has been found that the potentials are not reproducible, showing a constant drift and extraordinary differences in potential when the same liquid is tested on different days.

GENEVA.

Society of Physics and Natural History, June 4.—**Georges Tiercy**: The variation of the radial velocity of U Aquilæ. The author has employed an indirect method of determining the curve of radial velocities of the star U Aquilæ. He compares the result obtained with that given by the Mount Wilson Observatory obtained from direct measurement of spectrograms.—**R. Wavre**: (1) The theory of potential. The author shows that two distinct bodies having the connexion of the massive sphere cannot create the same potential, either round a point common to them if they have a small portion of common surface, or at any point in space if they are separated.—(2) Small vibrations of fluid stars. The author shows that the uniform method for research on the planetary figures applies also to stars which alter their shape in course of time; he applies it in particular to small movements and to the phenomena of tides on a perfectly fluid star.

LENINGRAD.

Academy of Sciences, *Comptes Rendus*, 1931, No. 4.—**B. Gerasimovic**: Probability theorems connected with the discovery of variable stars by a photographic method. Formulæ are given for cepheids and long-period variables, for eclipsing variables and for the probable number of variables in the field.—**V. Barovskii**: Description of a new species of the genus *Malthodes* Kiesw. (Coleoptera, Cantharididæ). *Malthodes kiritchenkoi* sp. n. is described from the Ussuri province.—**G. Nadson** and **G. Burgwitz**: Yeasts from the North Polar ocean. Yeasts belonging to the genus *Torula* have been found on the surface of sea-weeds *Laminaria saccharina*, *Alaria esculenta*, *Fucus vesiculosus* and *Rhodymenia palmata*. The yeasts can

develop at the temperature of 2°-4° C. The addition to the nutritive medium of 3 per cent of salt from the sea water depressed the intensity of the development of the yeasts. This suggests that the marine yeasts originated on land and only adapted themselves to life in sea.—**A. Krylov**: One of the main causes of the loss of airships *R* 38, *R* 101, and others. The author believes that the reason for airships breaking across the middle is the insufficient area of the rudder, which is therefore unable to withstand lateral forces when turning.—**A. Fersman**: A new law on the composition of granitic pegmatites. Pegmatite processes may be regarded as a series of systems in equilibrium subjected to fundamental physico-chemical laws. Pegmatite solutions must be considered as closed systems.

MELBOURNE.

Royal Society of Victoria, July 9.—**L. A. Thomas**: The readvancement of the vegetation over the mined areas of Bendigo.—**F. Chapman** and **Irene Crespin**: New species of *Lepidocyclina*, *L. hamiltonensis* and *L. howchini*, are described from a bore at Hamilton, Western Victoria. Other species hitherto found only in the East Indies, namely, *Lepidocyclina martini* and *L. radiata*, are illustrated from bores at Hamilton and Gippsland. *L. sumatrensis* var. *mirabilis*, lately described from the island of Formosa, is recorded from the Lower Miocene of Victoria. *Miogypsina mamillata* and *M. saitoi*, recently described from Formosa, are illustrated from borings and outcrops at Matapau, New Guinea.—**F. Chapman**: Two new Australian fossil king-crabs.—These belong to the orders Xiphosura and Synxiphosura respectively. *Pincombella belmontensis*, gen. et sp. nov., is a small though interesting predecessor of the living king-crabs and allied to the Carboniferous genus *Belinurus*; it was discovered at Belmont, Newcastle, N.S. Wales, and is of Permian age. The second form, *Hemiaspis tunnecliffei*, is related to one of the four species hitherto known from the Silurian of Scotland.

ROME.

Royal National Academy of the Lincei, March 15.—**U. Cisotti**: Determination of the function of a regular complex variable in a known circular corona: the real part on the external circumference and the imaginary part on the interior.—**M. La Rosa**: New proof of the influence of motion of the source on the velocity of light: ballistic explanation of Miss Leavitt's law (1).—**L. Cambi** and **A. Gagnasso**: Cobalt nitrosodithiocarbamates. In aqueous or aqueous-alcoholic suspension, and in absence of air, cobaltous dithiocarbamates actively absorb nitric oxide with formation of complexes of the type $[(R_2N.CS_2)Co.NO]$, which are in all respects analogous to those of iron. The nitroso-*N*:*N*-dimethyldithiocarbamate and the nitroso-*N*-piperidyldithiocarbamate are described.—**F. Tricomi**: The distribution of the baricentres of plane sections of a body.—**T. Boggio**: Laplace's operator and equations of elasticity in curved spaces.—**R. Calapso**: Wilczynski's prime directrix and problems connected therewith.—**Ugo Broggi**: The integration of linear equations to the differences with constant coefficients.—**G. Racah**: Characteristics of Dirac's equations and the principle of indetermination.—**Angelina Cabras**: The expression of the work in generalised spaces.—**G. A. Barbieri**: Contribution to the knowledge of rhodium compounds. The preparation and properties of a number of rhodiothiocyanates and rhodiocyanides are described.—**M. Airoldi**: Certain fossil Corallinaceæ of the Canaries.—**Amelia Tonon**: The structure of buds of the mulberry and their development.

Official Publications Received.

BRITISH.

Chelsea Polytechnic. Prospectus, Session 1931-32. Pp. 68. Chelsea School of Horticulture and Agriculture. Prospectus, Session 1931-32. Pp. 20. Chelsea School of Art. Prospectus, Session 1931-32. Pp. 15. Chelsea School of Chiropody. Prospectus, Session 1931-32. Pp. 8. Chelsea School of Cookery, Housecraft, Dressmaking and Millinery. Prospectus, Session 1931-32. Pp. 8. Chelsea School of Metallurgy. Prospectus, Session 1931-32. Pp. 14. Chelsea School of Pharmacy. Prospectus, Session 1931-32. Pp. 18. Chelsea College of Physical Education. Session 1931-32. Pp. 11. (London.)

Department of Agriculture, Trinidad and Tobago. Flora of Trinidad and Tobago. Vol. 1, Part 4: Rosales (Pars). By R. O. Williams. Pp. 197-308. (Trinidad: Government Printing Office.) 4*s.* 6*d.*

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1930. Pp. iv+29. (Trinidad.) 6*d.*

Trinidad and Tobago: Forest Department. Administration Report of the Conservator for the Year 1930. Pp. 22. (Trinidad: Government Printing Office.) 1*s.*

Society for the Promotion of Nature Preserves. Handbook 1931. Pp. 24. (London: British Museum (Natural History).)

FOREIGN.

Bulletin of the American Museum of Natural History. Vol. 62: The Auditory Bulla in some Fossil Mammals; with a General Introduction to this Region of the Skull. By C. J. van der Klaauw. Pp. 352. (New York City.)

Pacific Science Association. Proceedings of the Fourth Pacific Science Congress, Java, May-June 1929; held under the Auspices of the Netherlands Indies Science Council and supported by the high patronage of the Netherlands Indies Government. Vol. 1: General Part and Reports on Oceanography. Pp. x+379+iv+133+15 plates. Vol. 2A: Physical Papers. Pp. x+482. Vol. 2B: Physical Papers. Pp. iv+483-1093. Vol. 3: Biological Papers. Vol. vi+552. Vol. 4: Agricultural Papers. Pp. v+611. (The Hague: Martinus Nijhoff.) 60 guilders; £5; 25 dollars.

Rubber Research Institute of Malaya. Annual Report, 1930. Pp. 134. (Kuala Lumpur.) 1 dollar.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 31, Part 2: Beitrag zur physikalischen Chemie der Chromgerbung. Von Satoshi Sawayama. Pp. 19-164. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Imperial Academy. Vol. 7, No. 7, July. Pp. xix-xx+241-290. (Tokyo.)

CATALOGUES.

A List of Books: being Publishers' Remainders and other Purchases in New Condition as Published on sale at Greatly Reduced Prices. (No. 531.) Pp. 96. (London: William Glaisher, Ltd.)

Aerograph Finishing Equipment for the Electrical Industry. Pp. 8. (London: The Aerograph Co., Ltd.)

Coal Saving, the Key to Furnace Efficiency: some Simple Instruments for Fuel Economy. Pp. 8. Flow Operated Cut-Out. Pp. 2. Improved Absolute Vacuum Recorder. Pp. 4. Improved Level Gauge for Fuel Oil Tanks, Central Heating Installations and Water Storage Tanks. Pp. 2. Automatic Temperature Regulator. Pp. 8. Edgewise Thermometers for Diesel Exhaust Temperatures. Pp. 4. (London: Negretti and Zambra.)

Parsons Uniplane Turbo Generating Plant. Pp. 4. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 16.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—G. A. Wedgwood: Young's Modulus for Steel in Two Directions in a Bar.—Dr. N. W. McLachlan: On the Effective Mass of Flexible Discs and Conical Diaphragms used for Sound Reproduction.—A. T. McKay: Further Study of Diffusion for the Infinite Plane Sheet.—Miss Theresa Dillon and Miss C. Lovett: Demonstration of the Effects of Mechanical Disturbance on a Neon Lamp.

HISTORICAL ASSOCIATION (at 22 Russell Square), at 5.30.—Sir Bernard Pares: Russia since the War.

INSTITUTION OF MECHANICAL ENGINEERS (Special General Meeting), at 6.—Approval of Draft By-Laws.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 6.—J. McGovern: Presidential Address.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—Dr. A. F. Kertess: The Chemical Development of Modern Textile Finishing Products.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.15.—J. Bird: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas' Café, Swansea), at 7.30.—C. M. W. Grieb and R. H. Jones: The Influence of Sulphur Compounds on the Extraction of Nickel by the Carbonyl Process (Lecture).

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—Dr. W. Beaumont: Light Therapy, with particular reference to Ultra-Violet Irradiation.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. C. Berger: The Characteristics of Commercially Pure Iron.

NELSON TEXTILE SOCIETY (at Nelson Technical College), at 7.30.—J. Loxham: Wonderful Products from Coal.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology, Medicine, and Psychiatry Sections), at 8.15.—Discussion on Medical Indications for Premature Termination of Pregnancy.

ROYAL SOCIETY OF MEDICINE (Physical Medicine and Radiology Sections), at 8.30.—Dr. F. G. Thomson and Prof. W. Morison: Presidential Addresses.

SATURDAY, OCTOBER 17.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Southern District) (at Municipal Buildings, Newbury), at 11.15.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Technical School, Accrington), at 6.30.—F. J. Cook: Cylinders, for Steam, Diesels, and Compressors.

MONDAY, OCTOBER 19.

GENETICAL SOCIETY (at Linnean Society), at 3.30.—Dr. C. B. Bridges: Genic Balance and Related Problems.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Dr. R. Hutchison: Harveian Oration.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—P. M. Hogg: Chairman's Address.

INSTITUTE OF BREWING (London Section) (at First Avenue Hotel).—T. R. Dixon: Acids as Enzymic Activators in Malt and their Effect on Mashing Operations.

TUESDAY, OCTOBER 20.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of May, June, July, August, and September 1931.—S. L. Hora: Biological Notes on a Loricariid Fish from Brazil in the Society's Aquarium.—Dr. Ida Mann: Iris Pattern in the Vertebrates.—Margaret H. Fullarton: Notes on the Respiration of the Lungfish, *Lepidosiren*.—A. G. Lowndes: A Small Collection of Entomostraca from Uganda collected by Mr. G. L. R. Hancock.—V. V. Hickman: A New Family of Spiders.—G. Jennison: Cobras bred at Belle Vue Zoological Gardens, Manchester.

INSTITUTE OF FUEL (at Institution of Mechanical Engineers), at 6.—Sir Hugo Hirst, Bart.: Presidential Address.—B. Pochobradsky: Selected Problems relative to the Coal Industry.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 6.—H. W. Payne: Some Present Limitations in the Transport of Freight Traffic by Railway, with Suggestions.

ILLUMINATING ENGINEERING SOCIETY (at Lighting Service Bureau, 15 Savoy Street), at 6.30.—Report on Progress in Illuminating Engineering; Exhibits of Photometric Apparatus, Novel Lighting Fittings, etc.

LONDON NATURAL HISTORY SOCIETY (at London School of Hygiene and Tropical Medicine), at 6.30.—Dr. G. Carmichael Low: Some Structural Observations on the Waders (*Scolopacidæ*) and their Bearings on the Classification of the Family.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.—L. Romero: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. G. W. O. Howe: Chairman's Address.

IRON AND STEEL INSTITUTE (jointly with Sheffield Metallurgical Association) (at Sheffield Metallurgical Club, Sheffield), at 7.30.—J. H. Andrew, W. R. Maddocks, D. Howat, and E. A. Fowler: Equilibrium of Certain Non-Metallic Systems.—W. H. Cunningham and J. S. Ashbury: Surface Hardening by Nitrogen of Special Aluminium-Chromium-Molybdenum Steels on a Production Basis.—G. A. Hankins and M. L. Becker: Effect of Surface Conditions produced by Heat Treatment on the Fatigue Resistance of Spring Steels.—B. Matuschka: Solidification and Crystallisation of Steel Ingots: The Influence of the Casting Temperature and the Undercooling Capacity of the Steel.

ROYAL AERONAUTICAL SOCIETY (Bristol Branch) (at Bristol).—E. G. Gordon England: Soaring Flight; its Function in Aviation.

INSTITUTE OF BREWING (Scottish Section) (at Caledonian Hotel, Edinburgh).—G. H. Gemmell and R. G. Thin: Some Notes on Water Analysis.

WEDNESDAY, OCTOBER 21.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—Dr. R. S. Clay and T. H. Court: Some Early Achromatic Microscopes—Fraunhofer's Microscopes.—Dr. G. M. Findlay: Virus Inclusions in Mice Livers.

IRON AND STEEL INSTITUTE (jointly with Manchester Metallurgical Society) (at Engineers' Club, Manchester), at 7.—G. A. Hankins and M. L. Becker: Effect of Surface Conditions produced by Heat Treatment on the Fatigue Resistance of Spring Steels.—Prof. F. C. Thompson and R. Willows: A Critical Study of the Origin of the Banded Structure of a Hot-worked Hypo-eutectoid Steel.

INSTITUTION OF PRODUCTION ENGINEERS (Birmingham Section) (at Grand Hotel, Birmingham), at 7.—T. G. Heckles: Control of Factory Production.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—I. Scott Mackenzie: Chairman's Address.

FOLK-LORE SOCIETY (at Cecil Sharp House, 2 Regent's Park Road), at 8.—Miss Maud Karpeles: English Folk Dances, their Survival and Revival (with Illustrations by members of the English Folk Dance Society).

ST. PAUL'S ECCLESIOLOGICAL SOCIETY (at Royal Institute of British Architects), at 8.—N. H. Baynes: The Sacred Picture in the Greek Church.

SOCIETY OF GLASS TECHNOLOGY (at Science Museum), at 8.—E. Meigh: The Future of Glass Melting (Presidential Inaugural Address).

THURSDAY, OCTOBER 22.

SOCIETY OF GLASS TECHNOLOGY (at Science Museum), at 4.45.—Prof. W. E. S. Turner: Modern Artistic Glass (Lecture).

LINNEAN SOCIETY OF LONDON, at 5.—P. R. Lowe: Exhibit illustrating Structural Diversity in Charadriine Genera Correlated with Similarity of Colour-pattern.—S. H. Lele: The Circulation of Blood in the Air-breathing Chambers of *Ophiocephalus punctatus* Bloch.—Rev. H. J. Riddelsdell: Exhibit of Dried Specimens of the Yellow-flowered Privet.—Dr. L. Cockayne and Dr. W. A. Sledge: A Study of the Changes Following the Removal of Subalpine Forest in the Vicinity of Arthur's Pass, Southern Alps, New Zealand.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. A. F. Tredgold: Some Observations on Mental Development (Cockburn Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Capt. J. M. Donaldson: Presidential Inaugural Address.

INSTITUTE OF MARINE ENGINEERS (jointly with other Societies) (at Institution of Mechanical Engineers), at 6.—A. Bjorklund: Marine Reciprocating Steam Plants: Some Outstanding Factors of Economy.

INSTITUTE OF METALS (Birmingham Local Section) (at Birmingham University), at 7.—Sir William Larke: Inaugural Address.

ROYAL AERONAUTICAL SOCIETY (Gloucester and Cheltenham Branch).—Nickel and its Alloys (Lecture).

FRIDAY, OCTOBER 23.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Nature and Extent of the Changes which have Affected the Jaws of English People in Recent Centuries.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Lt.-Col. E. Kitson Clark: Presidential Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—I. Fagelston: Some Instruments used in connexion with Power Plant.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Prof. Major Greenwood: The General Register Office (Presidential Address).

ROYAL AERONAUTICAL SOCIETY (at Merchant Taylors' School).—C. R. Fairey: Lecture.

PUBLIC LECTURES.

FRIDAY, OCTOBER 16.

UNIVERSITY COLLEGE, at 5.—Dr. L. E. Bayliss: The Respiratory Functions of the Blood. (Succeeding Lectures on Oct. 23 and 30 and Nov. 6.)

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—E. C. Crittenden: The Measurement of Light: its Basis and its Significance. (Succeeding Lectures on Oct. 21, 23, 26, and 28.)

SATURDAY, OCTOBER 17.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 3.—H. S. Goodhart-Rendel: Some Opinions upon Furniture and Decoration.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Success and Failure in the Animal World.

MONDAY, OCTOBER 19

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. P. Denis: Some Geographical Problems in South America. (Succeeding Lectures on Oct. 20 and 21.)

UNIVERSITY COLLEGE, at 5.15.—Prof. F. Tobler: The Development of the Organism of Lichens: An Introduction to General Lichenology. (Succeeding Lectures on Oct. 20 and 22.)—At 5.30.—Prof. F. W. Thomas: Kings and Emperors of Ancient India.

UNIVERSITY OF LEEDS, at 8.—Prof. J. W. Cobb: The Kitchen Grate.

TUESDAY, OCTOBER 20.

UNIVERSITY OF LEEDS, at 5.—Prof. T. T. Read: The Rôle of Dentistry in Preventive Medicine.

KING'S COLLEGE, LONDON, at 5.30.—Sir Bernard Pares: Russian History to 1861: Kiev and the Water Road.

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lecturers on Oct. 21, 22, and 23.)

WEDNESDAY, OCTOBER 21.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Leonard Hill: Light and Air and the Health of the Citizen.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.—Lt.-Col. G. E. F. Stammers: Tropical Hygiene. (Succeeding Lectures until Oct. 30.)

ARMSTRONG COLLEGE (Newcastle-upon-Tyne), at 5.30.—Prof. Irvine Masson: Problems in the Teaching of Science (Alexander Pedler Lecture).

THURSDAY, OCTOBER 22.

KING'S COLLEGE, LONDON, at 5.30.—Dr. Eveline Martin: West Africa of To-day: Southern Nigeria: the Country, the People, and some Education Problems.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 5.30.—F. Wokes and F. J. Dyer: Some Applications of Bio-chemistry to Modern Pharmaceutical Problems.

SATURDAY, OCTOBER 24.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 3.—A. S. G. Butler: Tendencies in Modern Buildings.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. A. Rudd: The Legacy of Antiquity.

EXHIBITION.

OCTOBER 21 TO DECEMBER 31.

EXHIBITION OF MODERN TECHNICAL AND ARTISTIC GLASSES (at Science Museum, South Kensington). (Formal opening by Sir Richard Gregory, Bart., on Wednesday, Oct. 21, at 4.)

ANNUAL MEETING.

OCTOBER 31 TO NOVEMBER 2.

INTERNATIONAL SOCIETY OF MEDICAL HYDROLOGY (at American Hotel, Amsterdam).—Discussions on the Influence of Chill in the Causation of Disease, opened by Profs. Schade and van Loghem, and on Factors in Marine Treatment, opened by Prof. Moll and Dr. Häberlin.