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CONTENTS.



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## An English Folk Museum.

THE discussion on folk museums which took place in the Anthropological Section of the British Association at the recent Bristol meeting was singularly opportune. Following within a week or two on Mr. Lansbury's announcement of the appointment of a committee representing the Office of Works and the Board of Education to consider the question of the institution of such a museum in London, it furnished the occasion for educating public opinion on the nature and scope of the folk museum as it presents itself to those who have this matter at heart; at the same time it set out the grounds upon which the plea of urgency is held to justify such a proposal at a time when the financial conditions in Great Britain are anything but favourable to an undertaking of this kind.

The communication from Sir Henry Miers with which the discussion opened, and from which we print extracts elsewhere in this issue, was an admirably lucid and comprehensive survey of the situation in regard to folk museums both in England and on the Continent. After defining what he understood by a folk museum and briefly describing the various types of collection which may be brought within the definition, he pointed out that the proposal to set up a folk museum for England is by no means new. On many occasions during the last twenty years or more, the formation of a national folk museum has been urged with some insistency. Nothing has been done. A number of museums now include collections of folk material of varying size and importance for scientific study; but there is nothing which can be regarded as in the nature of a national collection.

With the issue of the Report of the Commission on National Museums and Galleries, the situation has changed. It is the definite recommendation of the Report that a folk museum for England should be established, and it even goes so far as to suggest two possible sites—the Botanic Society's grounds in Regent's Park, soon to be vacated, and Chiswick House. The recommendation has brought to a focus the efforts of those who for so long have seen the desirability—perhaps it would not be too much to say the necessity—of action in this direction before it is too late. In consequence, the Folk Museum Committee of the Royal Anthropological Institute, strengthened by the co-operation of the Royal Society, the British Association, the Folk-Lore Society, the Royal Society of Arts, and the Museums Association, has carried matters to a point at which a specific proposal is under official consideration.

Now that the question has reached this stage, there are certain considerations which should be kept to the fore. First and foremost, there is the matter of urgency. This emerges clearly when the nature and scope of the proposed museum are taken into account. It is suggested that in the main it should be of the open-air type, such as that at Skansen, the prototype of all existing open-air museums. The museum will confine itself to the arts and crafts, the surroundings and accompaniments of the daily life in past ages of the peasant and artisan—what is generally, if inaccurately, called the working class population. It is considered, and quite rightly, that the life and culture of the middle and upper classes is adequately illustrated already in other institutions. An essential feature of the proposed museum, however, is that this material should be exhibited in its natural surroundings—the appropriate setting of the actual houses, the humbler buildings and cottages, of the different periods of English domestic architecture in which it was used, each article of furniture in its appropriate room, each implement, each utensil, in its proper place, as if ready to hand.

Barns and other outbuildings of the farm, the smith's forge, wind- and water-mill, and other material accompaniments of the social and economic life of the English village, must be included to fill in the picture. The maypole on the village green, and possibly the holy well, will illustrate other sides of country life, even perhaps on occasion to be supplemented by the performance of folk- and country dances. On the other hand, for purposes of instruction, as well as of display and safety, a number of objects will have to be exhibited in an annexe in conditions more nearly approaching those of the ordinary museum. In this additional building also might be housed such administrative offices as are required.

It is scarcely necessary to enlarge upon the nature of the objects which should and could be brought together in such a collection, or to dwell upon their value from a scientific and educational point of view in illustrating the culture and character of the English people in the past. It should be realised, however, and that very clearly, that the opportunity for forming such a collection is growing less and less almost day by day. Those who know the rural districts of England will have seen here and there obsolete implements and domestic appliances, sometimes carefully cherished by those who have known their use in their youth, sometimes still in use by the conservative. In one agricultural district the wooden plough is still considered the only type suited to the soil; the old-fashioned Devonshire labourer sometimes carries his mid-day cider in a wooden firkin; in another remote district rare examples of the solid-wheel cart and old-fashioned wash-tub are carefully preserved. But whether now still in use or carefully preserved, sooner or later they will all be consigned to the dust-heap as the older generation and its memories die away, unless they are rescued by a kinder fate. Countless objects of priceless value for the study of English culture have vanished this way in the past; and unless some effort is made it will be too late to save even a part of what remains.

The spread of education and the standardisation of implements, utensils, and domestic appliances generally in modern industrial and economic conditions are tending with increasing rapidity to eliminate all that is individual and characteristic in the humbler arts and crafts. Especially is this the case with the rural dwelling with all that it can tell us of the past and in its local peculiarities—a very real product of its environment, eloquent of the different types of soil and landscape to be seen in England. These buildings, however, are rapidly disappearing before improved sanitation and the erection of model dwellings by local authorities as well as the urbanisation of the countryside. A folk museum would scarcely be fulfilling its function if it afforded an incentive to further work of destruction in order to provide housing for its collections. Unfortunately, there can be no question that ample provision will be made for its needs without any effort on its own part. Indeed, it should serve to save a few of the buildings which are now, or soon will be, condemned and beyond any other hope of preservation. Although the number of buildings of which the museum will be able to make use is limited, if only on account of space, it may yet serve on occasion to supplement the great work which is being done by the Royal Society of Arts for the preservation of characteristic dwelling-houses throughout the country.

Nor does it follow that the institution of a national museum should preclude the development of local folk museums and collections of folk-material. Indeed, the Anthropological Section, stimulated by Sir Henry Miers' account of what is being done in Sweden and elsewhere in this direction, urged the delegates of the corresponding societies of the British Association at Bristol to use their best endeavours to promote museums of this type in their respective localities.

Sir Henry Miers referred both specifically and by implication to the question of a site. Upon this

point much of considerable moment may be said. It is abundantly clear that a museum of the type suggested requires a considerable area for its effective display. The buildings cannot be dotted about indiscriminately all over the site. They should be arranged in something approaching the normal relation of buildings in an English village. On the other hand, any incongruity in period and style should be obviated by siting or by screening. The area available must therefore be considerable. A minimum of fourteen acres is suggested; but Skansen has sixty acres.

As regards situation, if the museum is to serve any effective scientific and educative purpose, obviously it must be readily accessible. It should be in or near some big centre of population. This immediately rules out such a suggestion as the Forest of Dean, which had something to be said in its favour on other grounds. Chiswick House has the advantage of being within easy reach of central London; but, unfortunately, the grounds are largely given up to sports and the amount of land available is inadequate. It has the additional disadvantage that the buildings in which a part of the collections would have to be displayed are very definitely 'period' buildings and of a type which would be incongruous with a folk collection.

It is generally agreed that London is the most appropriate centre for an English national museum, but here, if Chiswick House be ruled out for reasons mentioned above, at present only two proposals have come under consideration. Of these, one is that a site should be obtained adjacent to the Zoological Society's new grounds at Whipsnade. The distance—some thirty miles from London—is not so great an objection as might at first be thought. With the improved facilities for transport which are promised, Whipsnade will not be difficult of access. Further, the folk museum might count on the visits of a considerable proportion of those who come to the Zoological Society's grounds. Apart from the setting it would provide, however, Whipsnade cannot vie with the advantages of the grounds in Regent's Park. The area of the Royal Botanic Society's site is eighteen acres, and greater than could be obtained at Whipsnade except at a prohibitive cost; St. John's Lodge, a fine house adjoining, is available for purposes of the smaller exhibits and administration, and provision could be made for the continuation of the research work which is now being carried on in the gardens. If Mr. Lansbury's desire is that the Royal parks should be of lasting benefit to the population at large, could any purpose more fitting be found than a museum of the people for the people?

## Quantum Theory.

(1) *Introduction à l'étude de la mécanique ondulatoire.* Par Louis de Broglie. Pp. xvi + 292. (Paris: Hermann et Cie, 1930.) 85 francs.

(2) *Einführung in die Wellenmechanik.* Von Prof. Louis de Broglie. Übersetzt von Rudolf Peierls. Pp. iv + 221. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 13·80 gold marks.

(3) *Recueil d'exposés sur les ondes et corpuscules.* Par Louis de Broglie. Pp. 81. (Paris: Hermann et Cie, 1930.) 20 francs.

(4) *Quantum Mechanics.* By Prof. Edward U. Condon and Dr. Philip M. Morse. (International Series in Physics.) Pp. xiii + 250. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 15*s.* net.

(5) *Elementare Quantenmechanik.* (Zweiter Band der Vorlesungen über Atommechanik.) Von Prof. Dr. Max Born und Prof. Dr. Pascual Jordan. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 9.) Pp. xi + 434. (Berlin: Julius Springer, 1930.) 28 gold marks.

(6) *La nouvelle mécanique des quanta.* Par George Birtwistle. Traduction augmentée de 4 appendices par les traducteurs: M. Ponte et Y. Rocard. (Collection de monographies scientifiques étrangères publiée sous la direction de G. Juvet, No. 13.) Pp. vi + 333. (Paris: Albert Blanchard, 1929.) 75 francs.

(7) *L'ancienne et la nouvelle théorie des quanta.* Par Prof. Eugène Bloch. (Cours de physique théorique de la Faculté des Sciences de Paris.) Pp. iv + 417. (Paris: Hermann et Cie, 1930.) 90 francs.

(8) *Atoms, Molecules and Quanta.* By Dr. Arthur Edward Ruark and Dr. Harold Clayton Urey. (International Series in Physics.) Pp. xvii + 790. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 35*s.* net.

IT is now five years since Heisenberg made the great advance in atomic theory by the introduction of non-commutative algebra, and a few months less since Schrödinger gave the mathematical form to the undulatory conceptions of de Broglie. At first the progress was so rapid that if anyone had been rash enough to compose a book, it would have been obsolete before it was in type, but during the last year or so there has been a lull in the developments. The consequence is a whole crop of books written by a number of authorities on the subject, some of which are reviewed here.

Before describing the details of these works, it is of some interest to consider what different types of presentation are possible. There is first the historical. This is probably the easiest to write, since the succession of the discoveries must always provide a possible order of treatment, even though it may later turn out to have been an illogical one; it is also a form that is acceptable to those who have themselves lived through the developments, since it serves to give them pleasant reminiscences of dead theories. On the other hand, there is a suggestion in this treatment of what we may read in many industrial reports, that "much capital has been sunk in the present process, and the directors do not consider that it would be profitable to scrap the existing machinery, even though more economical processes are already in existence". The historical method also has the disadvantage of tending to upset the proportions. If it is followed here, it suggests that the quantum mechanics is a small addendum to the theory of spectra, whereas in fact the theory of spectra should occupy about the same position in quantum mechanics that planetary theory does in ordinary mechanics.

For the next generation there can be little doubt that it is no longer profitable to follow the historical method closely. What is wanted is something like the dynamical text-books, which enunciate the laws of Newton, without preceding them by an elaborate explanation of Galileo's experiments. There are still two choices open, according to where in the theory the emphasis is placed, whether on waves or on particles. This is a matter of taste, not of logic, and there will probably always be adherents of both sides. But we may perhaps discriminate between the tastes by an analogy from dynamics. Do we regard as the ultimate fact of dynamics that a particle's acceleration is proportional to the applied force, or that a dynamical system is a continually unfolding infinitesimal contact transformation? This is certainly an exaggeration of the distinction (and is perhaps a confession of partisanship on the part of the reviewer), but some writers do appear content to work out the relation of the new mechanics to classical Hamiltonian dynamics and leave it at that, whereas others make the attempt to get down to more primitive principles like those of Newton. Since atomic dynamics ought to be more primitive than molar dynamics, this last would seem to be the right policy, and the chief objection against it is that Newton's First Law must be replaced by a law expressing diffraction, rather a sophisticated idea to take as an axiom. So all we can say is that Nature itself offers us as starting-point the choice between two sophisticated ideas, that of diffraction and that of non-commutative multiplication, and everyone must choose for himself which he prefers.

(1) and (2) are respectively the French and German editions of the work of L. de Broglie, and they naturally follow the line of his own work and place the emphasis on the waves. The book begins with his well-known relativistic arguments and then passes on to Hamilton's association of dynamics with optics. There is then a good description of the general characters of waves, leading up to Schrödinger's equation. A special feature is the detailed working out of the separate behaviour of amplitude and phase, a separation that is not of much use in the actual discussion of problems, but helps in explaining the relation of the new mechanics to the old. The book then deals with electron diffraction and so proceeds to more complicated problems. A few actual cases are solved, but for the most part the work is devoted to an explanation of principles, including criticisms of those which have been tried and found wanting. The index shows that there are only two references to the word matrix—truly a striking difference from some of the other books under review. A novice would scarcely be able to start work on quantum problems without supplementing the present work by other reading, but he will gain insight into the wave aspects, and this will be a great help to him in getting a true, and not merely a technical, understanding of the subject.

(3) is a collection of five articles and addresses by the same author. They are of a semi-popular character, and are a pleasant and instructive exposition of his general outlook on the foundations of atomic physics.

(4) The work by Condon and Morse is much more of a text-book. It has the admirable quality of making the subject look simple and straightforward, and does not, like many other works, envelop it in an air of subtle mystery. After a general introduction it establishes Schrödinger's equation and works out a large number of examples connected with the spectra of atoms and molecules. Towards the end it explains the conceptions associated with matrices; this part is perhaps not quite so satisfactory, as it presents the theory in an earlier form and one which has not been found the best. We may also make another small criticism; it is rather surprising to find electron diffraction discussed in the very last pages of the book instead of the first. But these are minor defects, and, on the principle that the

learner wants much practice rather than much philosophy, the book can be strongly recommended as one which will give a very good working knowledge of the quantum theory.

(5) is a sequel to Born's well-known book on atomic mechanics. As such it is naturally concerned with the modifications of classical dynamics necessary in order to include the quantum theory, and indeed there is no mention at all of the wave equations. As an essay in how far can be gone without the use of partial differential equations it is brilliant, and contains full discussions of many problems which have not been given elsewhere, but as an exposition of the content of the quantum theory it must be judged a failure. We may even quarrel with the first word on the title-page, for to call the work "*Elementare* Quantenmechanik" is to give a very exaggerated idea of the difficulty of the other branches of the subject. The self-denying ordinance which has excluded wave equations severely limits the book's scope, for all continuous spectra are barred, and even the radial quantisation of the hydrogen atom is a very troublesome business, which can only be done by Pauli's method, a brilliant piece of work but one which can safely now be forgotten. In short, the only atomic problems that can be treated really well are those depending on the principle of angular momentum. But the book is to be followed by another part in which the wave methods are to be developed; this should redress the balance, and we can only regret that the two distinguished authors could not have issued both volumes together.

(6) is the French translation of Birtwistle's well-known book, which has already been noticed in the columns of NATURE (Oct. 6, 1928, p. 527). There are four appendices, added by the translators, on such things as the magnetic electron and the theory of metals.

(7) Prof. E. Bloch has issued in book form an excellent series of lectures on recent physics. It follows the historical sequence and traverses the whole field of recent experiments and theories, photoelectric effect, radiation, periodic table, and so on. It then turns to the new mechanics and covers the whole subject, again in historical sequence. It does not go so deeply into the matter as do the works previously noticed, but in view of the considerable space devoted to the description of experiments, that was not to be expected. It makes an admirable introduction to the whole of atomic physics.

(8) Messrs. Ruark and Urey's book, as its title implies, has a rather different purpose. Whereas the others stand for a new general dynamics, this is like a new astronomical dynamics, because its central interest is the structure of atoms and spectra. Two-thirds of the book is concerned with the old quantum theory, which still remains the most convenient way of summarising atomic structure, especially now that it is quite free from the confusion that used to arise in connexion with the exact values of some of the quantum numbers. This is excellent, and the only regret we may feel is that the authors could not find room for such things as a fuller description of Hund's theory of the ground states of atoms. The last part of the book is devoted to the new mechanics, and though it is perfectly sound it seems a little out of place; it is almost as though the Hamiltonian transformation theory were first introduced as an appendix to a book on the planets. But no doubt something of the kind was inevitable, for at the time of writing there was no book available from which this part of the argument could be quoted.

It will be seen that the new orientation of our physical ideas has led to a great variety of opinions as to what are the most important parts of the theory. There is no reviewer whose personal opinion would agree with all of them, but nevertheless they are all to be welcomed. Only so, by a synthesis of the conflicting opinions, can we hope to arrive at a universally acceptable view of the new dynamics. C. G. D.

## More Antarctic Meteorology.

*British Antarctic Expedition, 1907–1909. Reports on the Scientific Investigations. Meteorology.* By Dr. Edward Kitson. Pp. 188. (Melbourne: Council for Scientific and Industrial Research; London: Official Secretary, Australia House, n.d.) 8*s*.

THE Australian Department of Scientific and Industrial Research has earned the thanks of the scientific world for its action in rescuing, discussing, and publishing the meteorological results of Sir Ernest Shackleton's Antarctic Expedition of 1907–9. The Department was led to this good deed by the report of a committee in 1927 to the effect that "first-class scientific work by Australian investigators was sometimes in danger of being lost to subsequent workers owing to the impossibility of securing its publication". Why the records kept so conscientiously and so laboriously on the *Nimrod*, at Cape Royds, and on the magnetic pole and south pole journeys, have hitherto remained undivulged (save for brief summaries in "The Heart of the

Antarctic"), is not clearly explained. They appear to have been left in Australia or New Zealand on the return of the expedition, and we are glad that the participation as observers of Shackleton's Australian associates has made it possible for their government at last to publish the results. We are grateful to Sir Edgeworth David, of Sydney, and to Sir Joseph Kinsey, of Christchurch, N.Z., for their acknowledged share in enabling Dr. Kitson to prepare the observations for publication and to show the bearing of the expedition's results on the meteorology of the Antarctic region and of the southern hemisphere.

This Dr. Kitson has done with the skill and care to be expected from the director of the New Zealand Meteorological Service, equipped as he is for the task by a lifelong experience of Australian meteorology. The delay of twenty years in publication deprived Dr. G. C. Simpson of much important information which would have facilitated his great work on the meteorology of Scott's last expedition; but, on the other hand, it has enabled Dr. Kitson to make use of that work and of the labours of Meinardus on the observations of the *Gauss* expedition, thus focusing attention on the problems dealt with by those masters of meteorology.

The period covered by the observations at the land station at Cape Royds on M'Murdo Sound was from March 1908 to February 1909, midway in time between the *Discovery* and the *Terra Nova* expeditions in the same region. The data are set forth in tables of hourly value of temperature and two-hourly values of pressure, wind, and clouds. Temperatures are given to whole degrees Fahrenheit, a sensible saving of space, for fractions of a degree are meaningless on spirit thermometers read in the conditions of Antarctic observing. Humidity observations, accumulated hourly with infinite trouble, have only been summarised in monthly means, the manifold uncertainties of wet-bulb readings below the freezing point not justifying the labour of detailed discussion.

It was natural for Dr. Kitson to discuss his results with particular reference to Dr. Simpson's great memoir, and the new data have suggested more than a few frank criticisms of the earlier discussion, to some of which there may possibly be occasion for rejoinders. Dr. Kitson considers that his data throw doubt on the reality of the diurnal variation of temperature in the winter months detected by Simpson. It appears also that Scott's station at Cape Evans was less influenced in its minimum temperature by the 'cold layer' than the *Discovery* winter quarters thirteen miles farther south, or Shackleton's station at Cape Royds six miles farther north, a somewhat surprising result which is explained by the position of the Cape Evans thermometer screen on a slight elevation. Dr. Kitson brings out the fact that the cold layer of air streaming off the Barrier and down the mountain slopes was more pronounced on the surface of M'Murdo Sound, even when free from ice, than at the shore station where turbulence caused by the descent of cold air from the slopes of Mt. Erebus produced mixture and so raised the temperature.

Dr. Kitson's main contribution to Antarctic meteorology seems to be the elucidation of the phenomena of the cold layer and the katabatic winds associated with it. He recognises the power of chilling by radiation and by contact with a cold ice-surface to produce a layer of intensely cold air on the Barrier or on large ice-floes fed by the descent of cold air from the Plateau under the influence of gravity. He does not, however, see in this action so dominant a factor in the general circulation of the atmosphere as Prof. Hobbs claims for it, or as Sir Napier Shaw is willing to concede. He inclines to the belief that this cold layer remains apart from the system of air circulation produced by balanced forces. He considers that the polar anticyclone, if such a term is applicable, is confined to the cold layer, which he thinks can never exceed a kilometre in thickness, and that above it there is a polar cyclone playing its full part in the normal circulation of the earth's atmosphere. This is very like the old view put forward and upheld by Buchan on the basis of his Ben Nevis discussions, that every sea-level anticyclone has a cyclone riding on its back.

Dr. Kitson lays stress on the parallelism of the Antarctic pressure waves with the sequence of pressure changes in Australia, suggesting a close relationship between the two. In his discussion of the general problem of southern hemisphere meteorology he travels somewhat far from Cape Royds and the *Nimrod* and lands himself in the rather dazzling region of sunspot cycles.

Dr. Kitson urges the importance of establishing permanent meteorological stations on the Antarctic continent, as the variability of climate from one year to another is greater there than in temperate regions and a long series of observations is necessary in order to arrive at normal conditions. On the other hand, he wisely deprecates the somewhat rash assertions that have been made by the promoters of Antarctic expeditions (not, we believe, by meteorologists and geographers as he implies) that results of practical importance to temperate countries will immediately follow the establishment of meteorological observations in the Polar regions.

All climate, he recognises, is due ultimately to the circulatory movements of the atmosphere as a whole, and every addition to our knowledge of the whole must increase our knowledge of every part. To this extent and no further can the establishment of new stations in the Antarctic be of practical benefit to humanity.

When the results of the Byrd expedition are available, and the long-looked-for observations on the *Endurance* in the Weddell Sea are made public, there will be a mass of Antarctic meteorological data which may be worth the while of a meteorologist of the first rank to discuss on its merits, without worrying about the views of earlier investigators or endeavouring to penetrate the precise meaning which they have locked up in such terms as wave, stroph, cyclone, and anticyclone.

HUGH ROBERT MILL.

## A Chemical Engine.

*Die chemischen Vorgänge im Muskel: und ihr Zusammenhang mit Arbeitsleistung und Wärmebildung.* Von Prof. Otto Meyerhof. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 22.) Pp. xiv + 350. (Berlin: Julius Springer, 1930). 28 gold marks.

IN the course of evolution, animals have had to solve some exceedingly difficult problems of engineering; one of them, perhaps the most fascinating for us to study, was the elaboration of an internal combustion engine, made chiefly of water, working isothermally and without serious deviations from neutrality. The only ultimate source of energy in this world is the solar radiation, but the higher animals avoid part of the problem by utilising the energy stored in the organic compounds which the plants synthesise with the aid of the sun's radiation. For these animals, therefore, the problem is to convert the potential chemical energy of the food into useful mechanical energy in the limbs. The engine which does it is the skeletal muscle. It is not difficult to obtain mechanical energy from a fuel, given adequate oxygen—even man can do it—but muscle has a further remarkable property: even though it depends ultimately on an oxygen supply, it can work without oxygen for a considerable time. The sartorius muscle of a frog may be isolated and kept in pure nitrogen: it will then perform enough work to lift itself to the top of a mountain before it is exhausted. How is this done?

Prof. Meyerhof's book contains the answer, so far as we know it, in 318 pages of small print; and it is a matter for congratulation that he has managed, by skilful division and subdivision of the subject, to do it in so short a compass. For this is no elementary bird's-eye view, but a detailed account of the present position. The book contains ten divisions dealing with such aspects as respiration, metabolism, the chemical phenomena of activity in relation to the thermal and to the mechanical phenomena. Each of these is subdivided and again subdivided. Thus we find the topic of lactic acid production by minced muscles from added carbohydrates dealt with under III.*B*.1.*b*., and the relation between phosphagen breakdown in activity and the chronaxie of the muscle under II.*D*.3.*c*. Section II.*A*.2.*a*.*a*. deals with the dissociation constants of the hexosephosphoric esters. The list of contents is classified in corresponding detail. This arrangement, backed by an 8-page subject index, makes the book an excellent work of reference; yet this is accomplished without sacrifice of interest, for despite the detailed 'cataloguing' the text reads quite continuously. Matters of historical interest are referred to where they are appropriate, but no attempt has been made to give the full history of the subject.

The last four years have been particularly rich in discoveries in this field: facts have accumulated sufficient to overthrow the theories current in 1926, but insufficient to form the basis of new ones. Lactacidogen is gone: it turned out to be pyrophosphate. Most of the 'inorganic' phosphate of muscle is now known to be organic. Moderate activity in the absence of oxygen no longer makes a muscle acid—it now becomes alkaline or does not change at all. Lactic acid no longer initiates contraction; for a muscle may give twitch after twitch in nitrogen without any lactic acid accumulating. True, the muscle has been poisoned with iodoacetic acid, but it is not to be supposed that the muscle has invented a brand-new mechanism on the spur of the moment. The situation disclosed by Prof. Meyerhof in this book is indeed chaotic.

A considerable proportion of Prof. Meyerhof's theoretical treatment of the subject deals with the origin of the 370-400 calories of heat which accompany the formation of each gram of lactic acid in the muscle, and here we are moved to voice a protest. The heat of formation of lactic acid from glycogen in dilute aqueous solution may be calculated from the measurements of different workers, and it comes out to anything from 180 to 235 calories per gram of lactic acid. The uncertainty is chiefly due to the discrepant values for the heat of combustion of glycogen. The heat of neutralisation of lactic acid may be anything from 20 to 140

calories according as we use buffer salts or proteins for the neutralisation. Thus the combined heat of the two reactions may be anything from 200 to 375 calories—anything from one-half to the entire heat actually observed to accompany the process in muscle. For reasons which he gives in the text, Prof. Meyerhof takes the value 290 calories, but we feel that no amount of logic will compensate for uncertainty in the primary measurements.

The text includes 26 tables and 66 diagrams. The printing is well done, on good paper, but the binding is bad. There are two bibliographies; one contains 125 references to work performed in the author's laboratory, and the second contains 296 references to other work. There exists at the moment no treatise on muscle chemistry, in any language, so complete and up-to-date as this book.

PHILIP EGGLETON.

## Our Bookshelf.

*Annales de l'Institut Henri Poincaré: recueil de conférences et mémoires de calcul des probabilités et physique théorique.* Vol. 1, Fasc. 1. Pp. 74. (Paris: Les Presses Universitaires de France, 1930.) 35 francs.

THE Henri Poincaré Institute invites leading scientific workers to lecture on recent progress in mathematical physics. The "Annales", of which the first number has just appeared, will contain a French translation of these lectures. In the present number we have Einstein on the unitary field theory, C. G. Darwin on the wave theory of matter, and Fermi on the theory of radiation.

Einstein's lecture is addressed to mathematicians, in the hope of interesting them in a theory as yet very incomplete, but offering magnificent possibilities of development. He cannot account for certain identities that he has discovered, and he appeals to geometers to come to his aid. There is no possibility of verifying the theory by experiment until a certain mathematical problem has been solved.

Problems in quantum theory can be treated by the wave mechanics of de Broglie and Schrödinger, or by more abstract methods based upon the general theorems of analytical dynamics. Darwin considers that wave methods have the advantage of enabling one to deal intuitively with phenomena too complicated for mathematical treatment. The object of his lecture is the development of this intuitive power.

In the third lecture, Fermi shows how a uniform method can be applied to problems of interference and of the Compton effect, of which the first set are usually treated by classical methods and the second by quantum mechanics. The starting-point is Dirac's concept of the atom and radiation as forming a single system, the energy of which is the sum of three terms, due respectively to the atom alone, to the electromagnetic field, and to the interaction of the two.

Future issues will contain lectures by Born, Debye, de Donder, Kostitzin, Lévy, Pólya, and Volterra. H. T. H. P.

*The Magneto Manual: a Practical and General Reference Work for Automobile Engineers, Aeronautical Engineers, Mechanics, Apprentices, Chauffeurs, Car-Owners, etc.* By H. R. Langman. (Lockwood's Manuals.) Second edition enlarged. Pp. xii+246. (London: Crosby Lockwood and Son, 1930.) 7*s.* 6*d.* net.

IN many internal combustion engines the ignition of the explosive mixture is effected by means of an electric spark which is produced by a small machine called a magneto. The great demand for these machines for motor and aero engines has led to a very close study of the principles on which they work, and this has resulted in great improvements in their design. This book will prove useful to all engaged in motor engineering. The author wisely does not describe the functioning of any particular type of magneto, but confines himself to general remarks and a description of the outstanding features of the best types in everyday use. The trend of invention and industrial activity is in the direction of perfecting old types rather than the introduction of new types. In this edition a useful chapter has been added which gives a simple description of the theory of the high tension magneto. Many sketches are given depicting common faults. These should prove a help to driver owners of cars in maintaining their magnetos in good working order. The neon gas spark tester, the working of which depends on the low electric strength of neon, is described

*Metalliferous Mine Surveying.* By Thomas G. Hanton. Pp. xii+224. (London: Crosby Lockwood and Son, 1930.) 15*s.* net.

THE fundamental problem in mine surveying is the connexion between the surface and underground surveys and their relations to the boundaries of the property. In this book, which, unfortunately, the author did not live to see published, a successful effort has been made to present clearly and accurately modern methods of mine surveying with special reference to the correlation of the various parts of the work involved. Careful and practical descriptions of the instruments used are given, followed by details of survey practice and methods of preparing plans and sections and written records. Later chapters deal with stope surveys, estimation of ore reserves, and borehole surveying. The whole treatment is well proportioned, clearly written, effectively illustrated, and copiously provided with examples and calculations. Colliery surveying is not specifically dealt with, but the metalliferous mine surveyor has here a thoroughly up-to-date guide to all the leading features of his varied profession. The work was written by an Australian surveyor who had a wide experience, and his book represents the successful accomplishment of a difficult task.

## 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 Micelle Structure of the Wool Fibre.

THE real existence within the wool fibre of micelles which are impervious to water molecules and dyestuffs has only occasionally been suggested[1] and never demonstrated. Two independent lines of investigation have recently converged, not only to prove the existence of micelles, but also to give some idea of their shape and dimensions, and the manner of attack by certain reagents. In an earlier paper,[2] I was able to show that the size of the capillary spaces in the dry wool fibre is of the same order as the length of the *n*-propyl alcohol molecule. Whereas wool fibres in methyl alcohol and ethylene glycol are easily extensible, in butyl and amyl alcohols they resist extension to a degree closely similar to that of the perfectly dry fibre. When, however, the higher alcohols are mixed with methyl alcohol or ethylene glycol, these latter reagents enter the fibre and cause it to swell, opening the pores until they are able to admit the larger molecules. This is well illustrated by a comparison of the properties of wool fibres in octyl alcohol, ethylene glycol, and mixtures of the two. The potential energy necessary to extend fibres 30 per cent of their length in the various media at 22·2° C. was determined and typical results are quoted below :

| Medium. | Potential Energy (gm.cm. per c.c.). |
|---|---|
| Octyl alcohol . . . . . | $5{\cdot}17 \times 10^5$ |
| Ethylene glycol . . . . . | 1·63 ,, |
| Ethylene glycol–octyl alcohol . . . | 1·72 ,, |

The molecular concentration of ethylene glycol in the above mixture with octyl alcohol was only 60·8 per cent, and since the properties of the fibre in the mixture are almost identical with those in ethylene glycol alone, it seems clear that the pores of the swollen fibre are sufficiently large to admit the octyl alcohol molecule. This great increase in pore size is in striking contrast with the small increase in the over-all dimensions of the fibre. Swelling is greatest in water, but even in this case the increase in length of the dry fibre is only 1·1 per cent and the increase in diameter about 18 per cent. The co-existence of a large increase in pore size with a small increase in cross-sectional area affords a critical proof of the existence within the fibre of micelles which are relatively, if not entirely, impervious to molecules as small as the water molecule.

It has been found possible to extend the preceding argument to give a measure of the thickness of the micelles. Determinations of the potential energy required to stretch fibres were made in a series of mixtures of methyl- and octyl-alcohols. In the region of low concentration of methyl alcohol, the work required to stretch fibres at first decreased slowly with increasing concentration of methyl alcohol, as would be expected by analogy with the properties of wool fibres in atmospheres at various relative humidities. When, however, the concentration of methyl alcohol was great enough to produce a sufficient degree of swelling, octyl alcohol molecules could gain admission to the fibre, causing an immediate fall in the resistance to extension. Determinations of the increase in diameter of wool fibres in the critical mixture required to admit octyl alcohol, combined with the fact that the pore size must have been increased by the difference between the lengths of the *n*-propyl alcohol and octyl alcohol molecules, indicate that the thickness of the micelles must be of the order of 200 A. Knowing the increase in diameter of wool fibres in water, and making use of the preceding determination of micellar thickness, it can be shown that the pore size in fibres swollen in water is of the order of 40 A.

From a comparison of the changes in the elastic properties and size characteristics of wool fibres with water adsorption, I have previously deduced[1] that the micelles must be long in comparison with their thickness. Discrimination between the possible shapes which will fulfil this requirement was made possible from observations on the affinity of sodium sulphide treated wools for water. Known weights of purified Cotswold wool were treated with sodium sulphide solution for different times, the loss in weight being in each case ascertained after removing adsorbed sodium compounds by prolonged washing in distilled water. The amounts of water adsorbed by the dry, treated and untreated, wools were then determined at various humidities. A few typical results are given in the following table, the different wools being distinguished by indicating their loss in weight after reaction with sodium sulphide:

| Relative Humidity. % | Percentage by Weight of Water adsorbed by | | | |
|---|---|---|---|---|
| | Untreated Wool. | Sodium Sulphide treated Wools. | | |
| | | 13·0% loss. | 46·0% loss. | 56·7% loss. |
| 24·2 | 6·80 | 6·77 | 6·75 | 6·93 |
| 73·5 | 17·00 | 16·82 | 16·94 | 17·24 |
| 91·3 | 24·83 | 24·75 | 26·01 | 25·47 |

It is a highly significant fact that wool treated with sodium sulphide until the loss in weight is as high as 57 per cent should show almost exactly the same affinity for water as untreated wool. In view of the proved existence of micelles which are impervious to water, there can be only one possible explanation of the results : that the ratio of surface to mass remains unaltered with loss in weight. Combining this requirement with those indicated above, it becomes clear that the most probable shape of the micelles is the lamella, and that attack by sodium sulphide is largely confined to the edges, leaving the surface mass ratio sensibly unaltered. In addition, these observations indicate that the disulphide link in wool, which is the point of attack by sodium sulphide, must lie in a plane making an obtuse angle with the large faces of the micelles. Finally, there is now an obvious explanation of Marriott's[3] observation that treatment of hair with sodium sulphide until it shows a 26 per cent loss in weight leaves the ratio of the nitrogen and sulphur contents unaltered.

J. B. SPEAKMAN.

The University,
Leeds, Sept. 27.

[1] *J. Soc. Chem. Ind.*, **49**, 209 T; 1930.
[2] *Trans. Faraday Soc.*, **26**, 61; 1930.
[3] *J. Soc. Leather Trades Chemists*, **9**, 618; 1925.

### Hyperfine Structure in Some Spectral Lines from Highly Ionised Atoms of Thallium and Bismuth.

IN working with spectra in the extreme ultra-violet at the physical laboratory in Uppsala, I have been able to observe a hyperfine structure in some spectral lines in the region 1400-800 A. The lines investigated are due to higher ionisation stages of thallium and bismuth. For thallium, hyperfine structure has been measured before in the arc spectrum and in the first spark spectrum, and for bismuth, in the arc spectrum.

The lines now observed have in some cases much larger wave-number differences than any before measured.

The spectrograph is of the same type as two others designed by Prof. Siegbahn and described in other places.[1] It has a concave speculum grating with a radius of 1·5 m. and 1060 lines/mm.

The method with grazing incidence is used, and the angle of incidence is about 7°. The dispersion at 800 A. is 2·6 and at 1400 A. 3·4 A./mm.

The spectrograph has a volume of about 30 lit. and the vacuum is obtained by two Siegbahn molecular pumps in parallel backed by an oil-pump. As light source is used a condensed spark with a condenser of about 0·3 $\mu$F in parallel with the spark. The charging current for the condensers is rectified by a kenotron.

It is possible to measure these small separations only when narrow lines of the proper intensity are obtained. It is, therefore, necessary to work with a very narrow slit and use different exposures for different lines.

The possible errors in wave-length differences are estimated to about 0·01 A., which corresponds to 1 cm.$^{-1}$ in wave-number.

Table I. gives the separations of some previous classified lines in Tl III [2] and Tl IV.[3] Some of these

TABLE I.—THALLIUM.

| $I$. | $\lambda$ (A.). | $\Delta\lambda$ | $\Delta\nu$ cm.$^{-1}$ | Classification. |
|---|---|---|---|---|
| ·7-7 | 1266·33 | 0·103 | 6·4 | III. $s^2S_{\frac{1}{2}} - p^2P_{\frac{3}{2}}$ |
| ·7-7 | 1337·19 | 0·060 | 3·4 | IV. $s^3D_3 - p^3F_3$ |
| ·2-3 | 1358·58 | 0·077 | 4·1 | IV. $s^1D_2 - p^3F_2$ |
| ·4-2 | 1374·62 | 0·056 | 3·0 | IV. $s^3D_1 - p^3D_2$ |
| ·7-7 | 1377·75 | 0·092 | 4·7 | IV. $s^3D_3 - p^3P_2$ |
| ·7-7 | 1404·60 | 0·065 | 3·8 | IV. $s^3D_2 - p^3F_3$ |
| ·2-3 | 1412·93 | 0·094 | 4·7 | IV. $s^1D_2 - p^3P_1$ |
| ·3-3 | 1434·71 | 0·070 | 3·4 | IV. $s^1D_2 - p^3D_2$ |

The values of the wave-lengths are from Carrol's [6] measurements.

lines are seen on the magnified plates reproduced in Fig. 1.

The separation measured for the level 6 $^2S_{\frac{1}{2}}$ of Tl III is 6·4 cm.$^{-1}$. From the spectrum of Tl II,

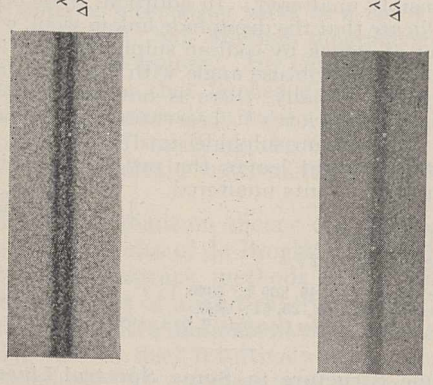


FIG. 1.—Thallium. Magnified 54 times.

Bacher and Goudsmit [4] have calculated a value between 7 and 8 for this level.

Table II. and Fig. 2 give the separations of four lines in the spectrum of bismuth: two doublets and two triplets. The two triplets are classified by Lang [5] in the way given in the table as belonging to Bi III. With respect to the fine structure, it would be very strange if this classification should prove to be correct.

According to Bacher and Goudsmit's theory, if the

TABLE II.—BISMUTH.

| $I$. | $\lambda$ (A.). | $\Delta\lambda$ | $\Delta\nu$ cm.$^{-1}$ | Classification (questioned). |
|---|---|---|---|---|
| 8-8 | 864·5 | 0·092 | 12·9 | |
| | | 0·064 | 5·3 | |
| 2-2-3 | 1103·4 | | | III. $6s^26pP_1 - 6s^27sS_1$ |
| | | 0·085 | 7·0 | |
| 10-10 | 1139·4 | 0·175 | 13·4 | |
| | | 0·126 | 7·3 | |
| 6-5-5 | 1317·1 | | | III. $6s^26pP_2 - 6s^26dD_3$ |
| | | 0·099 | 5·7 | |

The wave-lengths are calculated from reference lines of oxygen, nitrogen, and carbon.

splitting of the triplet is due to one level only, it must have $j = 1$. Since the nucleus quantum number $I = 4\frac{1}{2}$, for bismuth, then the resultant $F = 3\frac{1}{2}$, $4\frac{1}{2}$, $5\frac{1}{2}$. The ratio of the separations in the triplets would be expected to be $11/9 = 1{\cdot}22$.

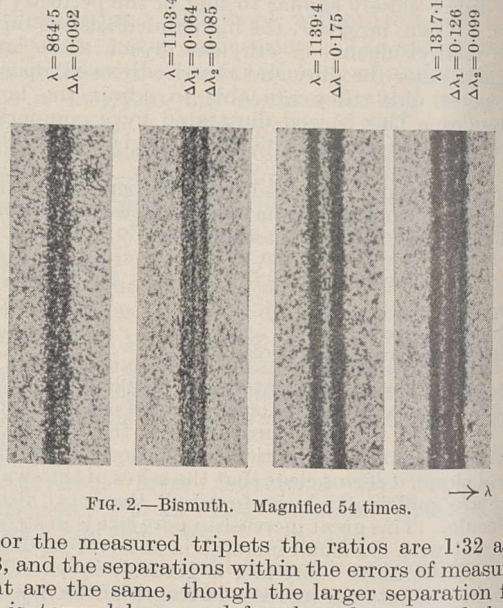


FIG. 2.—Bismuth. Magnified 54 times.

For the measured triplets the ratios are 1·32 and 1·28, and the separations within the errors of measurement are the same, though the larger separation for one is toward long, and for the other toward short wave-lengths. One would then expect them to correspond to transitions between 6 $s$ 6 $p$ $^3P_1[(6\ s\ 6\ p_{\frac{1}{2}})_1$, Goudsmit's notation] and a more stable term 6 $s^2$ $^1S_0$ and a less stable term, for example, 6 $s$ 7 $s$ $^1S_0$ or 6 $p^2$ term.

It can be expected that the possibility of measuring the hyperfine structure in these regions will prove to be a good tool for classifying spectra from some highly ionised heavy atoms. This aid is much needed. In general, lines from many different stages of ionisation are mixed together and the possible error in wave-number increases rapidly as the wave-length decreases.

GUSTAF ARVIDSSON.

The Physical Laboratory of the
University of Uppsala,
Aug. 29.

[1] Ericson and Edlén: *Zeit. f. Phys.*, **59**, 656; 1930. Erik Ekefors: *Physik. Zeitschr.*, **31**, 737; 1930.
[2] McLennan, McLay, Crawford: *Roy. Soc. Proc.*, A, **125**, 50; 1929.
[3] J. E. Mack: *Phys. Rev.*, **34**, 17; 1929. K. R. Rao: *Phys. Soc. Proc.*, **41**, 361; 1929.
[4] S. Goudsmit, R. F. Bacher: *Phys. Rev.*, **34**, 1304; 1929.
[5] R. J. Lang: *Phys. Rev.*, **32**, 737; 1928.
[6] A. Carrol: *Phil. Trans.*, A, **225**, 375; 1925–26.

### Rate of Growth of the Common Starfish, *Asterias rubens*.

IN the course of a study of the growths on the buoys and beacons in Liverpool Bay marking the entrance to the Mersey Estuary, young *Asterias rubens* have in nearly all cases been found clinging to the undersides of those structures. There is no doubt that these starfishes have settled as larvæ in this position and have grown *in situ* by feeding on coexisting mussels (*Mytilus edulis*), which have always been found in abundance. As definite observations on the rate of growth of the common starfish are necessarily rare and difficult to obtain, the following are of interest.

On May 30, 1930, the black beacon *Q*7 from the Queen's Channel was dry-docked and examined, and found to be carrying a large number of young *Asterias rubens*. About 1800 of these were collected, preserved in the laboratory, and afterwards measured to give the graph shown in Fig. 1. The measurement adopted

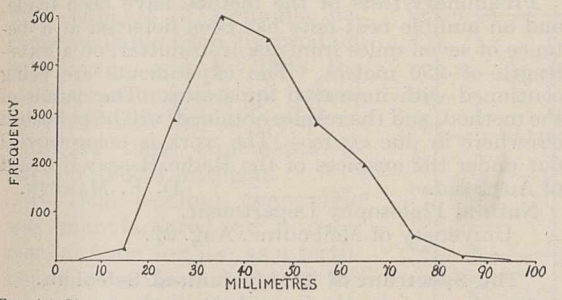


FIG. 1.—Size-frequency in 10 mm. groups of 1805 *Asterias rubens* (aged not more than 1 year) from the black beacon *Q*7, Queen's Channel, Liverpool Bay, May 30, 1930.

to give a criterion of size is the length of the straight line joining the tips of alternate arms. The modal value in Fig. 1 is nearly 4·0 cm., while size ranges between 7 mm. and 9·4 cm., and the mean value is 4·2 cm. In life these specimens would measure in repose about 5 mm. more on the average. As the buoy *Q*7 was placed on station on April 3, 1929, the greatest age of these *Asterias* is about 13 months. The actual age is, however, rather less. Post-larval *Asterias* of only a few millimetres were obtained in 1930 on a buoy (*C*8 black) on July 25—and rather larger sizes in great quantities on other buoys at a later date—thereby proving that settlement occurs in this stage and giving also an indication of the date of settlement.

If post-larvæ be assumed to settle in general on buoys from about June onwards, then it is seen that a population of *Asterias* may attain a maximum size of about 10 cm. and a mean of 4-5 cm. in less than one year. But as *Asterias* probably spawns round about April in this locality, the actual age (from the time of fertilisation) of these small starfishes is approximately one year. It is an extremely interesting fact that minute post-larval *Mytilus* were obtained on another buoy (*Q*3 black) on June 27, 1930, at just about the right time to serve as food for the growing baby *Asterias*. The latter have not been observed actually eating the post-larval mussels, but there can be little doubt that this is the source of their sustenance. Young mussels were probably also largely the food of *Echinus miliaris* taken from the bottom of the Bar lightship along with 15 cm. *Asterias rubens*, large mussels, medium *Actinoloba dianthus* and other forms, also on June 27, 1930. These *Echinus*, it may be noted, were mostly the long-spined variety, and were similar in this respect and in size to those obtained on the coal hulk *London City* (see NATURE, **111**, p. 146; 1923). As these sea-urchins could only attain access to the bottom of ships by the settlement of larval forms, and as this lightship was put out on Nov. 22, 1927, their age, as well as that of the larger *Asterias*, is not more than two years.

We are greatly indebted to Capt. Mace and Mr. A. L. Hulme, of the Mersey Docks and Harbour Board, who kindly supplied information regarding the records of the buoys mentioned above.

J. H. ORTON.
J. H. FRASER.
The University, Liverpool, Aug. 28.

### Depreciated Morphology.

IN a recent review (NATURE, Sept. 6, p. 341), Prof. Elliot Smith reproves at some length an anonymous group of contemporary biologists whose attitude towards morphology is one of ill-concealed contempt. Escaping the discipline which alone attends the laborious drudgery of morphological research, they pour contempt on that field of biology which, in the past, has yielded all our richest fruits. Few biologists will read Prof. Elliot Smith's remarks unmoved. Some will learn, for the first time, that there is a race of upstarts—presumably experimental biologists—who not only ignore, but also despise, the foundations of their own beliefs. Others—perhaps no insignificant minority—will learn with dismay of the great gulf which protects the true morphologist from the taint of experimental corruption.

I venture to think that the picture is not quite so dark as Prof. Elliot Smith has painted it. Whether we use a macerating pot or an X-ray for the study of animal form, the goal remains the same—to show how the component parts of an animal (whether they be bones or molecules) are so shaped and so orientated to one another as to form a living organism capable of undergoing evolutionary change. To this end the morphologist (in the classical sense) has contributed, and is continuing to contribute, a more complete record of correlated facts than his younger colleagues in experimental laboratories can hope to do for many years to come. Nevertheless, the final goal will not be reached by those who restrict their conceptions of animal life to the facts revealed by a scalpel and a microtome, or by those who ignore all knowledge of the anatomical sciences. Until we can add to such facts as are described in Prof. Goodrich's distinguished volume a knowledge of the form and mechanism concealed within a muscle fibre and a gamete, the theories of the evolution of the vertebrate skeleton will necessarily remain vague and unsatisfying to certain types of mind.

Facts of real biological significance are drawn from an ever-widening field, and there is an inevitable tendency to specialise in apparently unrelated territories. To some extent this is inevitable, but whether we regard an organism as an intricate piece of molecular machinery or whether we prefer to examine the brain with a hand lens, it scarcely seems necessary to allow our predilection for one or other point of view to imply a negation or an implied criticism of the other. It is just as inconsistent to ignore the morphological significance of experimental data as it is to study the behaviour of an organism without reference to its form or evolutionary history. If experimental biologists are too fond of ' looping the loop', it is equally true that morphologists are not disinclined to creep about on all-fours.

It is to be hoped that experimental biology will never be regarded as the antithesis to morphology. There is no intrinsic virtue in experiment—it is solely an additional weapon of biological armament. The very name ' experimental ' is a misnomer and might well be replaced by ' analytical ', for this at least indicates an attitude of mind of those who attempt to analyse

living phenomena in terms of matter and energy, and who try to regard experiment and observation with strict impartiality. The only difference between such misguided folk and Prof. Elliot Smith's declining band of faithful warriors lies in the belief that the rich harvest of classical morphology would provide more palatable food, for the young, if leavened by a knowledge of physiological facts.

It is depressing to think that a study of living organisms inevitably entails severe morpholophobia and that the only cure is a return to the dead. In spite of anxious and widespread inquiry, I have failed to discover any genuine case of this unfortunate disease; perhaps it only affects the very, very young.

J. GRAY.

King's College, Cambridge.

### Ovoviviparity in Sea-Snakes.

MR. SMEDLEY'S note on viviparity in the sea-snake (*Laticauda colubrina*) in NATURE of Aug. 30, p. 312, needs some comment. My statement (which he quotes) that all sea-snakes are viviparous was not a reiteration of that of previous authors, but a confirmation, based upon personal knowledge of the group. In the light of fresh information, however, it requires some qualification.

The recent investigations of Miss Weekes have shown that true viviparity, with the formation of a placenta, first described in *Chalcides* by Giocomini in 1891, occurs in some Australian lizards (*Lygosoma* and *Tiliqua*) and snakes (*Denisonia*), and it would be well in future to restrict the term viviparous to those species in which some form of placentation can be shown to exist. Whether the sea-snakes are truly viviparous or not, is unknown, but that the majority of the species of the subfamily Hydrophiinæ produce their young alive is a well-established fact. All the members of that group are strictly aquatic in their habits and never seek the land, and no other form of reproduction therefore seems possible for them. With the *Laticaudinæ*, genera with broad ventral shields and partly terrestrial habits, it is different. I have recently examined a specimen of *Laticauda colubrina* with well-developed embryos enclosed in a thin semi-transparent covering, and also an example *Aipysurus eydouxi* with young less well developed and enclosed in a thicker capsule. From their position in the body of the mother it was evident that they were not yet ready for expulsion and that further development would have taken place before they were discharged. These species, therefore, appear to be ovoviviparous.

The eggs laid by Mr. Smedley's snake are no doubt similar to those deposited last month by the same species of snake in the Zoological Society's Gardens in London, and which are—in view of what has just been stated—eggs that have been prematurely laid in consequence of captivity. The fact that they were laid one by one at intervals of a few days, supports this conclusion.

MALCOLM SMITH.

London, Sept. 7.

### Measurement of the Heaviside Layer Heights.

IF the carrier wave of a wireless transmitter be increasing steadily in frequency, then a given receiving station will in general pick up two waves differing in frequency. One of these waves will have reached the receiver by the shortest path along the ground, while the other will arrive after having suffered reflection at the Heaviside layer. After rectification these two waves will give rise to a beat-note in the receiver. It is possible to arrange that this note shall have an audible pitch, and a determination of the latter may be used to obtain a measurement of the height of the layer. The resulting method possesses some advantages, such as simplicity, and is besides adapted to the obtaining of continuous records.

In practice, it is not possible to continue increasing the carrier frequency indefinitely, but this difficulty is overcome by alternately increasing and decreasing the frequency many times a second, the rate of increase being constant and equal to the rate of decrease. It is evident that, corresponding to the change over from increasing to decreasing frequency at the transmitter, there will occur at the receiver a short period during which the frequency of the beat-note decreases rapidly to zero and rises again to its former value. The duration of this period must be made small compared with the time during which the beat-note remains steady. This condition is satisfied in practice by ensuring that the time during which the carrier frequency is increasing (or decreasing) shall be large compared with the time difference of the two ray paths.

Preliminary tests of the method have been made, and an audible beat-note has been detected at a distance of seven miles from the transmitter, on a wavelength of 250 metres. The experiments are being continued with improved apparatus. The details of the method, and the results obtained, will be published elsewhere in due course. The work is being carried out under the auspices of the Radio Research Board of Australia.

D. F. MARTYN.

Natural Philosophy Department,
University of Melbourne, Aug. 22.

### The Spectrum of Trebly-Ionised Selenium.

THE spectrum of selenium has been investigated (in Prof. Fowler's Laboratory at the Imperial College, in collaboration with Mr. J. S. Badami) from λ7000 to λ700, using different intensities of discharge, through capillary tubes containing selenium metal or the oxide. Between λ1400 and λ500 photographs have also been taken in this institute of the spark spectrum of selenium with a vacuum spectrograph designed by Prof. Siegbahn, having a grating of radius 150 cm., at tangential incidence. With the aid of these, the doublet system of trebly-ionised selenium, due to the configurations $4s^2 4p$, $4s^2 4d$, etc., and $4s4p^2$, has been identified. The characteristic separations are: $4p^2P_1 - 4p^2P_2 = 4378$; $5p^2P_1 - 5p^2P_2 = 1198$; $4d^2D_2 - 4d^2D_3 = 389$, etc. Details of the analysis will be published shortly.

K. R. RAO.

Physical Laboratory,
University of Uppsala, Sept. 18.

### British Museum (Natural History): General and Departmental Libraries.

WITH reference to a review, appearing in the Supplement to NATURE for Oct. 4, of the list of place-numbers of societies issuing serial publications contained in the General Library of the British Museum (Natural History), I have been desired to point out that this List, being a *General* Library List, does not include the more special serials housed in the five Departmental Libraries of the Museum. This would account for the list's apparent weakness in specific branches of natural science, so justly commented upon by your reviewer.

A. COCKBURN TOWNSEND
(Assistant-Keeper in charge of the General Library).

British Museum (Natural History),
London, S.W.7, Oct. 3.

THE preface to the volume noticed does not contain any reference to the five Departmental Libraries; but I accept unreservedly Mr. Townsend's correction of my comments.

THE REVIEWER.

# The Nitrogen Industry and our Food Supply.*

By Dr. R. E. SLADE.

FOR many centuries nitrogen was used as a fertiliser in the form of farmyard manure, and certain rotations of crops, which kept up the nitrogen in the soil, had been popular; but it was not until 1840, when Liebig first pointed out the true function of nitrogen, potash, and phosphorus, that fertilising became an art based on science. Liebig's work became widely known in a very short time. A little later Lawes and Gilbert started their experiments at Rothamsted, which definitely proved the part taken by nitrogen in agriculture.

From 1840 the use of nitrogen in the form of Chile nitrate steadily increased, and about 1880 sulphate of ammonia became available from by-product coke ovens, and by 1903 the world consumption of these two fertilisers had increased to 1,975,000 tons, equivalent to 351,000 tons of nitrogen.

In 1905 calcium cyanamide was manufactured on a commercial scale for use as a fertiliser, and in the same year the arc process for combining the oxygen and nitrogen of the air to form nitric acid was launched unsuccessfully in Canada. Two years later the arc process was established in Norway and calcium nitrate was put on the market as a fertiliser. Thus Crookes's dream of the commercial production of nitrogenous fertilisers from the nitrogen of the air was realised in less than ten years. But it was the Haber-Bosch process for the fixation of nitrogen which was to supersede all others and make it possible for us to produce all the nitrogen fertilisers we require now and as far in the future as we can see. In 1906–9 Prof. Haber investigated the chemical equilibrium between nitrogen, hydrogen, and ammonia when heated under a pressure over a catalyst. Then Dr. Bosch of the Badisch Analin u. Soda Fabrik successfully manufactured ammonia on a large scale by this process in 1913 to 1914.

The fixation of nitrogen in the form of ammonia is so much cheaper than by any other process that this process has very largely replaced the cyanamide and arc processes, and it has shaken the Chile nitrate industry to its foundations—so that the Chilean Government and the nitrate manufacturers have to revise their methods and their processes.

The production of nitrogen in various forms is shown in Fig. 1. The quantities are expressed in tons of nitrogen contained in the products. It will be noticed that the nitrogen industry had already achieved considerable importance in 1898, but it was not until 1921 that the synthetic nitrogen production became greater than the Chilean nitrate production.

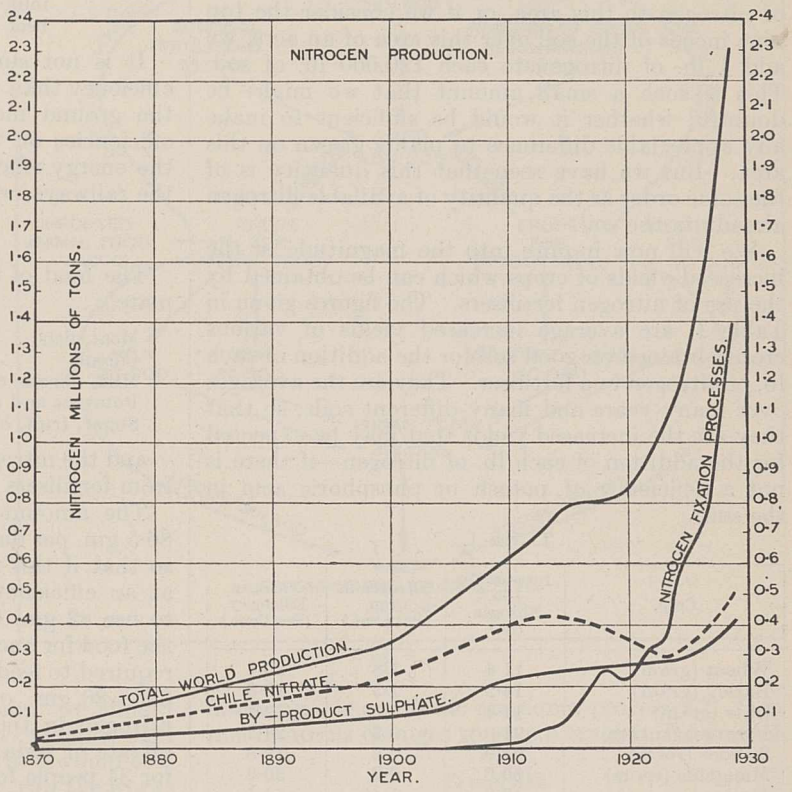


FIG. 1.

## NITROGEN FERTILISERS.

The world's consumption in 1928 of nitrogen in the form of ammonium sulphate from synthetic ammonia and by-product coke ovens, cyanamide, nitrate of lime, nitro-chalk, and ammonia liquor was 1,442,000 tons and in the form of Chile nitrate 401,000 tons, making a total of 1,843,000 tons, of which 185,000 tons are used in industry and 1,658,000 tons are consumed as fertilisers. If fixed nitrogen is worth £50 a ton—which is about its price in sulphate of ammonia to-day—then the value of the nitrogen used in fertilising was £83,000,000.

Now, in an acre of typical English arable soil we have in the top nine inches a quantity of humus containing about 2500 lb. of nitrogen, and at certain times of the year changes take place in the soil making some of this nitrogen into nitrates, in which form it is available for absorption by the plant. The result of this is that in the spring about one per cent of the nitrogen in the humus is present

* From an evening discourse delivered at the meeting of the British Association at Bristol on Sept. 9.

in the form of nitrate ; thus we have present about 25 lb. of nitrogen available for the plant. As this available nitrogen is used up by the plant it is partly replaced by more nitrate being formed from the humus, but during the time of greatest growth there is a considerable depletion of available nitrogen in the soil. Owing to the continuous breaking down of the humus, the nitrogen absorbed by the plant is often more than 25 lb., besides what is washed away by rain. The supply of available nitrogen may be increased by the addition of nitrates or ammonium salts—for the latter are rapidly oxidised to nitrates in the soil.

If we spread one hundredweight of sulphate of ammonia over an acre of ground, this adds 23 lb. of nitrogen to this area, or if we consider the top nine inches of the soil over this area of an acre, we add 1 lb. of nitrogen to each 120,000 lb. of soil. This is such a small amount that we might be doubtful whether it would be sufficient to make any appreciable difference to plants grown on this area. But we have seen that this quantity is of the same order as the quantity of available nitrogen already in the soil.

We will now inquire into the magnitude of the increased yields of crops which can be obtained by the use of nitrogen fertilisers. The figures given in Table I. are average increased yields of various crops obtained on good soil for the addition of each lb. of nitrogen in a fertiliser. They are the averages over many years and many different soils, so that they are the increased yields that may be expected for the addition of each lb. of nitrogen—if there is not a deficiency of potash or phosphoric acid in the soil.

TABLE I.

| Crop. | Increase for 1 lb. Nitrogen. (lb.) | Nitrogen in Crop. (Per Cent.) | Nitrogen Efficiency. (Per Cent.) |
|---|---|---|---|
| Wheat (grain) . | 11·4 | 1·8 | 20·4 |
| Barley (grain) . | 14·2 | 1·3 | 18·5 |
| Oats (grain) . . | 12·4 | 1·6 | 19·7 |
| Potatoes (tubers) . | 94·0 | 0·3 | 28·2 |
| Swedes (roots) . | 94·0 | 0·2 | 18·8 |
| Mangolds (roots) . | 150·0 | 0·2 | 30·0 |
| Hay. . . . | 42·3 | 1·45 | 61·5 |

The nitrogen efficiency of the fertilisers in the last column is the percentage of the nitrogen in the fertilisers which appears in whole or part of the crop described in the first column.

In Table II. the increased yields are recalculated so as to show the increased crop obtained from one hundredweight of sulphate of ammonia in common units.

TABLE II.

| Crop. | Increase for 1 cwt. of Sulphate of Ammonia. |
|---|---|
| Wheat . . . | 4·5 bushels or 2·41 cwt. |
| Barley . . . | 6·5 ,, or 3·02 ,, |
| Oats . . . | 7·0 ,, or 2·62 ,, |
| Potatoes . . . . . | 20·0 ,, |
| Swedes . . . . . | 20·0 ,, |
| Mangolds . . . . . | 32·0 ,, |
| Hay . . . . . | 9·0 ,, |

If we feed grass to a cow giving two gallons of milk a day, we find that 1 lb. of nitrogen causes sufficient extra grass to grow to keep the cow alive one day and to give two gallons of milk. Since two gallons of milk contain 0·8 lb. of proteins or 0·128 lb. of nitrogen, we have 12·8 per cent of the nitrogen of the fertiliser appearing in the milk, or the efficiency with which the fertiliser is used via grass to make milk is 12·8 per cent.

The efficiency of meat production is lower, one pound of nitrogen fertiliser only producing 0·05 lb. of nitrogen in beef, or an efficiency of 5 per cent on the fertiliser.

Summing up these nitrogen efficiencies we have:

| | | |
|---|---|---|
| Fertiliser to grain . . | about 20 per cent. |
| ,, potatoes . | ,, 30 ,, ,, |
| ,, grass or hay . | ,, 60 ,, ,, |
| ,, milk . . | ,, 12·7 per cent. |
| ,, beef . . | ,, 5 per cent or lower. |

It is not surprising that grass shows a higher efficiency than other crops, because the roots cover the ground more completely. I think that the efficiencies on the whole are very high ; compare the energy efficiency of a high-class locomotive on the railways, which is not more than 8 per cent.

## FOOD PRODUCTION.

The food of a man in Great Britain is approximately:

| | |
|---|---|
| Meat, fish . . . . . | 14·5 per cent. |
| Cereals . . . . . | 18·5 ,, ,, |
| Milk, cheese, etc. . . . | 24·5 ,, ,, |
| Potatoes and roots . . . | 25·8 ,, ,, |
| Sugar, fruit, etc. . . . . | 15·5 ,, ,, |

—and the nitrogen efficiency in growing these foods from fertilisers is probably about 17 per cent.

The amount of protein consumed per head is 86·5 gm. per day ; this contains 14 gm. of nitrogen, so that if this food were grown by using fertilisers at an efficiency of 17 per cent we should require to use 82 gm. of nitrogen in fertilisers to produce the food for one person for one day ; or the fertiliser required to feed one person for a year must contain $365 \times 80$ gm., or 29 kgm. of nitrogen. One ton of nitrogen in the form of sulphate of ammonia or nitrate of soda will therefore produce enough food for 34 people for one year.

Since the total amount of nitrogen consumed in fertilisers during 1928 was 1,658,000 tons, the amount of extra food produced from this fertiliser would contain enough nitrogen in the form of proteins to support 56,000,000 people ; and there would be sufficient carbohydrates and fat associated with this protein to form a complete diet.

Sir Daniel Hall has shown that 2-2½ acres of land are required under cultivation to feed one person. Let us compare this with 1/34 tons of fixed nitrogen. If we assume that the total capital required to build a nitrogen factory is £70-£100 per ton year of nitrogen, inclusive of everything, then for a maximum of £3 invested we can support one person. It would be impossible to bring 2-2½ acres of land under cultivation at so low a capital cost. I do not think that land can usually be settled and cultivated at a less capital cost than £10 per acre, including roads and railways, houses, and agricultural machinery, so that to bring two and a half

acres under cultivation would need £25 capital as compared with £3 necessary to produce the fertiliser to produce the same amount of food. I would particularly like to direct attention to this calculation in some countries where governments are always ready to consider and finance schemes to build railways and roads to open up new country or to build irrigation schemes, although the capital to be invested for a given amount of food-producing capacity is often enormous.

### Stability of the Nitrogen Fixation Industry.

In fixing one ton of nitrogen and making it into fertilisers we use for all purposes about five and a half tons of coal, so that to provide the fertiliser to feed one person for a year we require $3\frac{1}{4}$ cwt. of coal. The population of the world (excluding China and Turkey) is now about 1940 millions, and 56 millions or 2·8 per cent are now being fed with food grown by nitrogen fertilisers. Of the nitrogen fertilisers consumed in the year 1928, about 1,000,000 tons of nitrogen was produced by synthesis, needing 5·5 million tons of coal. This quantity of coal is almost negligible when compared with 1500 million tons mined every year. The rest of the nitrogen was produced by by-product coke ovens or as nitrate of soda from Chile.

The population of the world increased by 10 millions each year from 1913 to 1928. If we had to feed this increase of population by increased nitrogen fertilisation, we should have to build each year a works which would fix 300,000 tons of nitrogen per year and would cost upwards of £30,000,000. In order to run the works we should require 1·6 million tons of coal per year. If we built a works of this size every year for a hundred years, we should then be consuming 160 million tons of coal a year for nitrogen fixation, or only ten per cent of the coal which is being used in the world to-day. At least two-thirds of the coal consumed in the fixation of nitrogen is used for power production, so we could reduce the coal required to one-third the value mentioned if other sources of power were available. There are still large areas of the world suitable for cultivation. It is therefore improbable that all the food requirements for the growing population of the world will have to be supplied exclusively from nitrogenous fertilisers for some time to come.

### Distribution of Nitrogen Fertiliser.

Let us now investigate the use which the world makes of the nitrogenous fertilisers available at the present time. I have already mentioned that of the 1,843,000 tons of nitrogen consumed in 1928, 1,658,000 tons or 90 per cent was used in agriculture.

In Table III. are shown the quantities of nitrogen consumed in the different countries during the year 1928.

How much atmospheric nitrogen is combined by electric discharges ? How much by bacteria ? How much by our synthetic ammonia processes ? How much humus changes to give nitrate ? How much nitrate is washed away and how much goes into

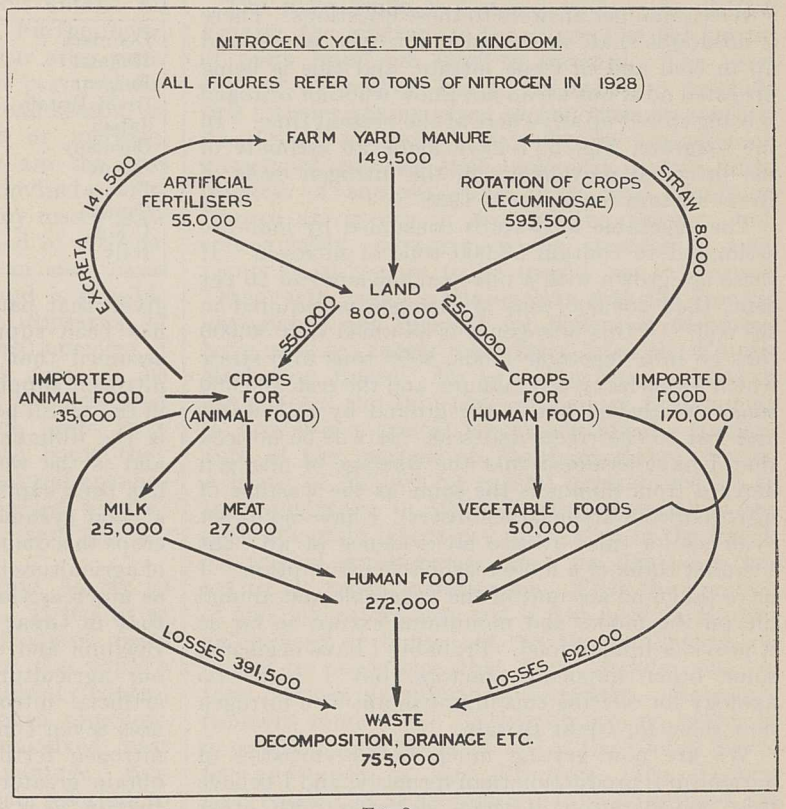


Fig. 2.

Table III.

| | Nitrogen Consumed. | |
|---|---|---|
| | Metric Tons, 1928. | Lb./Acre Arable. |
| Germany | 615,200 | 22·3 |
| France | 166,900 | 6·7 |
| Belgium | 63,600 | 45·9 |
| Czechoslovakia | 33,800 | 5·0 |
| Denmark | 29,100 | 9·8 |
| Holland | 73,400 | 70·6 |
| Italy | 68,300 | 4·7 |
| Poland | 54,600 | 2·7 |
| Spain | 67,300 | 3·8 |
| Great Britain | 61,600 | 10·4 |
| Total (Europe) | 1,134,800 | .. |
| U.S.A. | 383,600 | 2·4 |
| Japan | 113,300 | 16·8 |
| Egypt | 35,900 | 9·2 |
| Other countries | 175,600 | .. |
| Total (World) | 1,843,200 | .. |

the crop? What happens to that going into the crop and how much of it forms humus? What happens to the dissolved nitrogen going down the rivers into the sea? How much comes back to land in the form of fish? Again, how much nitrogen is liberated again from combination? Is there a dynamic equilibrium in this nitrogen cycle—or are we drifting in one direction? Are we gaining nitrogen in the air or are we losing it?

We cannot get answers to these questions. There is no doubt that, in the past, nitrogen was stored up in coal and in Chile nitrate, and this is being liberated now, but we do not know whether nitrogen is being stored up anywhere at the present time. In the diagram, Fig. 2, I have made an estimate of the principal movements in the nitrogen cycle of Great Britain for the year 1928.

The vegetable food-stuffs consumed by man are estimated to contain 50,000 tons of nitrogen. If these are grown with a nitrogen efficiency of 20 per cent, then 250,000 tons of nitrogen is required in the soil. Of this nitrogen it is assumed that 50,000 tons go into vegetable foods, 8000 tons into straw which forms farmyard manure, and the rest, 192,000 tons, are washed out of the ground by rain water and lost to the rivers and seas. It will be noticed that I have assumed that the wastage of nitrogen derived from humus is the same as the wastage of nitrogen from artificial fertilisers. I have no direct evidence for this—I have no evidence at all; but I cannot think of a more reasonable assumption. I have taken no account of the vegetable and animal life on the moors and mountains except so far as it provides human food. Probably I have neglected some other important factors, but I make no apology for offering this first attempt at a nitrogen flow sheet for Great Britain.

We are now getting much better statistics of agricultural production than formerly, and I believe that consideration of these statistics with other statistics now available has opened up new fields of study in agricultural economics. I have calculated the average amount of nitrogen obtained from an acre of crops in different countries. The figures in Table IV. are for the year 1928. They were obtained by calculating the weight of nitrogen in each crop for each country and then adding up the total amounts of nitrogen for each country. This weight of nitrogen is then divided by the area on which the crops grew and we get the weight of nitrogen in the crop in lb. per acre average over the whole country. By crop we mean the portion of the crop taken away for consumption by man or animals: for example, of wheat the grain, of potatoes the tubers, etc. The rest of the crop usually goes back to the land and is considered as part of the agricultural system of the country.

Since some crops give a larger yield of nitrogen, in the useful part of the crop, than others, the figures in the table are to some extent affected by the different crops and different proportions of each crop grown in the country. But so far as I can see, the effect of the different crops grown is of only minor importance, and as the production of proteins is the farmers' business, we are not far wrong in considering the first column as an index of the agricultural efficiency of that part of the country under crops. In the second column is given that part of the nitrogen in the crop which has been supplied by artificial fertilisers. It is assumed that on an average 25 per cent of the nitrogen supplied to the land as fertiliser is found in the useful portion of the crop. The third column is the difference between the other two columns and is the weight of nitrogen in the crop which has been supplied by the land. In countries with a good system of farming and a good rotation of crops this quantity is high. We see that the system of agriculture in Denmark produces more than twice as much as that in Canada, U.S.A., and Italy, and that in Great Britain we are a little better than Belgium and considerably better than Holland in our agricultural system, apart from the use of artificial nitrogen fertilisers. But since Holland uses seven times and Belgium four times as much nitrogen fertiliser per acre, these two countries obtain greater crops than those obtained in Great Britain, as is shown in the first column.

TABLE IV.

| Year 1928. | Lb. per Acre. | | |
|---|---|---|---|
| Country. | Total Nitrogen in Crops. | Nitrogen in Crops from Artificial Fertilisers. | Nitrogen in Crops from Humus. |
| Denmark . . | 52·0 | 2·4 | 49·6 |
| Holland . . | 49·0 | 17·6 | 31·4 |
| Belgium . . | 47·2 | 11·5 | 35·7 |
| Great Britain . | 40·2 | 2·6 | 37·6 |
| Japan . . | 34·2 | 4·2 | 30·0 |
| Germany . . | 32·5 | 5·6 | 26·9 |
| Egypt . . | 31·6 | 2·3 | 29·3 |
| France . . | 23·5 | 1·7 | 21·8 |
| Canada . . | 21·8 | 0·1 | 21·7 |
| U.S.A. . . | 20·8 | 0·6 | 20·2 |
| Italy. . . | 20·5 | 1·2 | 19·3 |

In Holland one-third of the crops appear to be grown from nitrogen fertilisers. There seems to be no climatic or other physical reason why fertilisers should not be used to a greater extent in Great Britain. If we used as much per acre as in Holland, we should consume 420,000 tons of nitrogen per year; if as much as in Belgium, 272,000 tons; and if as much as in Germany, 132,000 tons. The reason that we do not use more fertilisers does not appear to be economic. The use of sulphate of ammonia yields 100-300 per cent on the money invested within a year. Consider the special case of the fertilisation of wheat. For some years the price of wheat and of sulphate of ammonia has been practically equal. Since 1 cwt. of sulphate of ammonia gives an increased yield of wheat of 2·4 cwt., even after paying for phosphatic and potash fertilisers, one hundred per cent will be earned on money spent on nitrogen.

Development of the nitrogen fixation industry has lowered the price of nitrogen fertilisers, so that we can expect the needs of the increasing population of the world to be met first by more intensive cultivation of land close to the markets for food rather than by extension of the cultivated area.

## The Biological Method of Pest Control.

By Dr. A. D. IMMS, F.R.S.

PHYSICO-CHEMICAL methods of controlling noxious insects present the advantage that they generally check their activities sufficiently to enable the grower to produce a reasonably satisfactory crop. They are, however, at the best only palliatives the application of which entails an increase in costs of crop production. Furthermore, they usually need to be repeated year after year, because they fail to reduce a given pest population to a low enough level, in any one season, to prevent its subsequent recurrence or increase. For the most part, however, they are the best general control measures so far devised. Notwithstanding this fact, there are many insect pests that are not amenable to any method of artificial control. In attempting repression in such cases other means have to be sought, and a possible method often presents itself in the utilisation of the natural parasitic (and predaceous) enemies of specific pests. This procedure has come to be known as biological control, and it has produced the most encouraging results where pests have become accidentally introduced into lands they did not previously inhabit. Their natural enemies being left behind, such pests, unchecked by biological agents of this kind, quickly gain the ascendancy.

Biological control aims at restoring, so far as possible, the missing parasite factor. It has to be remembered that some of these introduced pests are numbered among the worst of the world's enemies of food supplies. Artificial control measures have, in many cases, proved impracticable and their application has involved vast expenditure of money to no real advantage. Biological control has consequently been resorted to as a sounder and, in the end, a less expensive measure. In a number of cases highly satisfactory results have been achieved, but the method is too immature to forecast its ultimate possibilities and its limitations with any certainty. Every year, however, brings fresh records of promising results, but it cannot be regarded as a universal panacea as the misinformed are too prone to view it.

The first essential for success is technical knowledge of the behaviour of specific parasites in relation to their hosts, from every point of view. Such knowledge forms the guiding principle in biological control work: it enables the most suitable parasites to be selected and the chances of failure or mistakes to be reduced. The collection of biological data of this kind is the work of highly trained entomologists, who must have the use of the equipment and technique pertaining to a subject which has its special requirements. They must also be field naturalists, capable of studying the ecology of parasites in different countries in relation to different conditions. A further necessity is experience in the transportation of delicate insects over many thousands of miles of land and sea, where drastic climatic changes may be encountered *en route*. At the destinations of these living cargoes fully trained specialists are likewise necessary. Familiarity with the handling, breeding, and liberation of parasites under favourable conditions can alone prevent loss of valuable material and wasted effort.

The more trade is fostered within the British Empire, the greater are the chances of the spread of pests from one land to another. The most efficient quarantine has so far failed to preclude this transfer taking place at one time or another. As already mentioned, it is largely against such introduced enemies that biological control offers promise of success. The basic food plants of Europe are grown in most of the Empire, and, consequently, parasites of the enemies of such plants have mainly to be sought out in Europe. These facts, taken in conjunction with the growing importance and demand for biological measures, have received timely recognition from the Empire Marketing Board. By providing financial aid it has enabled the Imperial Institute of Entomology to establish a special laboratory for the furtherance of the method at Farnham Royal, Bucks. A grant of £15,000 for capital expenditure led to the foundation, in 1927, of what is certainly the most adequate laboratory of its kind in the world. An annual maintenance grant for five years has led to its rapid development. That the creation of this laboratory has met a real need in Empire entomology is borne out by the number of requests for assistance that have already come in from various dominions and colonies. Its establishment renders the British Empire no longer so dependent upon the good-will of the United States for assistance in this direction. The Federal Government at Washington has fully realised the value of biological control and now expends more than £100,000 per annum on work of this character.

A general account of the aims and underlying principles of biological control has been recently published by the Empire Marketing Board in a *Bulletin*,* under the authorship of Dr. W. R. Thompson, the superintendent of the Farnham Royal Laboratory. In the same publication he gives a full and most interesting description of the organisation, facilities, and progress of the work of the Laboratory. During the brief existence of the latter more than 73 consignments of beneficial insects, containing over 285,000 living individuals, have been sent out to where demands came. These consignments represent about 24 species attacking about 17 different kinds of hosts. Also about 29,000 examples of Chrysomelid beetles have been shipped to Australia with the view of attempting to control St. John's wort by the aid of their phytophagous propensities.

This *Bulletin* is to be commended to all entomologists and to anyone interested in the practical applications of biology. In one respect it is unique,

* "The Biological Control of Insect and Plant Pests. A Report on the Organisation and Progress of the Work of the Farnham House Laboratory." Pp. 124+7 pl. E.M.B. 29. By Dr. W. R. Thompson. (London: His Majesty's Stationery Office, 1930.) 1s. net.

in that it explains the whole procedure of biological control and its underlying principles. It will obviously prove most helpful to have such information gathered together in so convenient and authoritative a form. There may be differences of opinion here and there on the theoretical side of the subject, but only one criticism of any importance need be raised. On page 25 an erroneous impression is conveyed with reference to the outstanding work of the Hawaiian entomologists and their methods. Probably in no part of the world has greater skill or care been exercised in biological control than in these Pacific Islands, and the successes achieved have been truly remarkable.

## Radio Telephony at the Rugby Station.

PROGRESS is being made rapidly in the development of the Post Office radio transmitting station at Rugby. On the invitation of Sir Thomas Purves, Engineer-in-Chief to the Post Office, who is also president of the Institution of Electrical Engineers, many of the members of the Council of the Institution visited this station on Sept. 30 and were much impressed by the new developments.

In 1927, the first international telephone service designed for connexion with the ordinary telephone subscribers' system was started with one channel between the United States and England. There are now four channels and preparations are nearing completion for a fifth channel. Two of these channels use long waves and three short waves. The short wave systems are cheaper to erect, but they are not so trustworthy as the long waves. For the latter system, there are twelve masts, each 820 feet high, supporting the antennæ. The single side band telephone transmitter G.B.T. is the most powerful radio telephone transmitter in the world. Its wave-length is 5000 metres (60 kilocycles) and its output is equivalent to a broadcast transmitter of 1000 kilowatts. It is wonderful to notice how a current of several hundred amperes is apparently transmitted directly into the ether.

There are now a large number of smaller towers arranged in groups called ' arrays ', the heights of which vary from 120 to 180 feet. These towers are used to support the antennæ for the short wave beam telephone services. The arrays are so arranged that the beam is projected in the direction of the great circle joining the transmitting to the receiving station. Three different frequencies are used, depending on the time of day the message is sent, and the message sometimes travels one way round this great circle and sometimes the other way.

The G.B.R. telegraph transmitter is the most powerful one in the world and works at 600 kilowatts and 16 kilocycles. The ninth harmonic of a tuning fork which oscillates at 1777·7 cycles is used to tune the circuit. In the final amplifier stages of G.B.R. each panel contains eighteen cooled anode valves.

By combining both short wave and long wave systems, the Post Office can now provide an effective service to America over the full twenty-four hours. It is not considered possible to operate long wave systems to greater distances than from England to North America. The solution of the problem of providing communication with the Dominions has been obtained by the use of short wave transmission.

In order to prevent unauthorised persons from ' listening in ' to the private telephone messages which are now being sent almost continuously, a method has been devised of making the speech as transmitted quite incoherent to the would-be listener. The component parts of the speech are ' scrambled ', that is, they are split up into portions by an electrical device and transmitted in this state, being finally rearranged in their correct form at the distant end. Demonstrations were given to the visitors, through the medium of a loud speaker, of the London side of conversations with New York through the long wave channel. The scrambled speech sounded absolutely meaningless. A somewhat different system of scrambling is adopted in the short wave system. In this case the frequencies of the various sounds are inverted, the high frequency sounds becoming low frequency and vice versa. The sounds produced by the waves in the intermediate stages remind one of barking dogs or crowing cocks.

The Rugby station is used for the ship and shore telephone service. The messages to the *Majestic*, the *Olympic*, the *Leviathan*, and other vessels, are sent out from here.

The electric power required to work the station is obtained from the system of the Leicestershire and Warwickshire Power Company by means of two underground cables, each capable of taking the full load of the station. The cables can be connected to either the Warwick or Hinckley power stations, so that the risk of a failure of the power supply is almost negligible. Short wave services to Australia, South Africa, Canada, India, and the Argentine are either complete or nearing completion. As the site covers 900 acres, there is plenty of room for extension.

## Obituary.

### PROF. W. D. MATTHEW, F.R.S.

PALÆONTOLOGISTS, zoologists, and geologists mourn the loss of Dr. William Diller Matthew, professor of palæontology in the University of California, who died on Sept. 24, aged fifty-nine years. For thirty years he shared the charge of the fossil vertebrates in the American Museum of Natural History, New York, and added greatly to the collection by his own discoveries in the western States. In 1927 he was appointed to the professorship at Berkeley, where he looked forward to extending the palæontological museum of the University of California by renewed activity in collecting fossils on the Pacific border of the American continent.

This important task, for which Prof. Matthew was so well fitted, has unfortunately been interrupted by his untimely death.

Matthew was born at St. John, New Brunswick, Canada, the son of Dr. G. F. Matthew, a well-known Canadian amateur geologist who added much to our knowledge of the oldest fossiliferous rocks of eastern Canada. He inherited the disposition for geological research from his father, and on leaving school proceeded to Columbia University, New York, where he eventually graduated as Ph.D. In the beginning, his inclinations were towards mineralogy and mining geology, and his first scientific paper dealt with topaz from Japan. For three or four years he spent his leisure in studying the crystalline and volcanic rocks of New Brunswick, and he published several valuable results. At the same time, he was an all-round naturalist, and his papers on some American species of the plant *Cuscuta* and on a trilobite *Triarthrus* show an early interest in the world of life. He attracted the notice of Prof. H. F. Osborn, who was then beginning to organise the great department of vertebrate palæontology in the American Museum of Natural History, and in 1897 he was selected as one of Prof. Osborn's assistants. Thus began his career as a distinguished student of extinct mammals and other higher vertebrates.

Matthew's first original research at the American Museum was a revision of the earliest remains of Tertiary mammals found in New Mexico, and his paper on the subject published in the Museum bulletin at the end of 1897 showed that these mammals belonged not to one but to two successive faunas, the Puerco and the Torrejon. It was the beginning of a long series of technical descriptions of the remains of Tertiary mammals which appeared in the Bulletin and Memoirs of the American Museum of Natural History, and is interesting as already displaying the keen insight into the bearing of the facts on wide problems which characterises all Matthew's writings. Cope had supposed that the bones of the two rows of the carpus and tarsus in the earliest Tertiary mammals were always directly opposite, and that interlocking began only in later groups. Matthew proved that such interlocking had already begun in the earliest Eocene.

As examples of his later publications may be specially mentioned those on the deer, early rodents, and cats. He showed that the deer must have evolved in the Old World, and that their succession in North America resulted from a series of immigrations. He described and discussed a group of Eocene rodents which may have been the primitive stock from which many later groups descended and diverged. He distinguished among the fossils from the Oligocene period onwards two parallel series of Felidæ, one ending in the existing true cats, the other in the sabre-toothed tigers which became extinct just before historic times. These and many other problems in the evolution of mammals Matthew discussed finally, with fullness of knowledge and experience, in a valuable paper entitled "The Evolution of the Mammals in the Eocene", in the *Proceedings* of the Zoological Society of London for 1927.

In a more general way Matthew was also interested in the extinct birds and reptiles. In 1917 he joined Mr. Walter Granger in a valuable description and discussion of the skeleton of a gigantic running bird, *Diatryma*, from the Eocene of Wyoming. With Mr. Barnum Brown he described Megalosaurian Dinosaurs from the Cretaceous of Alberta. He also described part of a skull of the only known horned Pelycosaurian from the Permian of Texas.

While occupied with this detailed research, Matthew meditated on many general questions which confront the geologist and palæontologist, and he summarised his ideas in two most suggestive publications. The first is entitled "Climate and Evolution", in the *Annals of the New York Academy of Sciences*, vol. 24, 1915. The second is a synopsis of lectures in palæontology in the University of California issued in 1928. Our knowledge of the evolution of the land vertebrates of past times is supposed to be scanty because those which inhabited the uplands and forests are scarcely ever represented among fossils. The early mammals are so imperfectly known because they lived in the forest regions of the north—Siberia, Canada, or Alaska—which have not yet been thoroughly explored. Dispersal and evolution are said to be due chiefly to geographical and climatic changes.

Matthew's scientific researches are recorded not only in his own publications, but also in other works of the American Museum, of which he was a most generous and unselfish helper. In later years he co-operated in interpreting the wonderful discoveries of fossil mammals in Mongolia, and in 1926 he himself visited China to further the research in progress there. Nor did he neglect the educational aspect of the Museum's activities. His handbooks on "The Evolution of the Horse", "Mammoths and Mastodons", and "Dinosaurs" are admirable examples of popular exposition.

Matthew's quiet, lovable personality, delightful sense of humour, and unassuming scholarship made him a welcome guest wherever he appeared in his many travels, and he had a multitude of friends. He retained his Canadian nationality to the end, and was elected a fellow of the Royal Society in 1919.

A. S. W.

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WE regret to announce the following deaths:

Mrs. Anna Botsford Comstock, emeritus professor of nature study at Cornell University, and wife of Prof. J. H. Comstock, emeritus professor of entomology in the same university, on Aug. 23, aged seventy-five years.

Rev. J. G. Hagen, *S.J.*, director of the Vatican Observatory for more than twenty years, on Sept. 5, aged eighty-three years.

Mr. E. M. Holmes, emeritus curator of the Pharmaceutical Society of Great Britain, an authority on materia medica and also on algæ, on Sept. 10, aged eighty-seven years.

Dr. E. Alberta Read, assistant chief of the micro-analytical laboratory of the U.S. Bureau of Chemistry, Department of Agriculture, and distinguished for her work on histology, on Sept. 1.

## News and Views.

No disaster of post-War years has so deeply touched the minds and hearts of English-speaking peoples as that which overtook the airship *R101* near Beauvais early last Sunday morning. The airship, considered by those responsible for its design, construction, and navigation, as well as by those men of science who have laboured for years to make lighter-than-air vessels proof against the vagaries of the elements which they have to encounter, as the embodiment of safety, within a few hours of its release from its mooring mast at Cardington was reduced to a blackened framework of metal, and most of its crew and all its passengers, including Lord Thomson, Secretary of State for Air; Sir Sefton Brancker, Director of Civil Aviation; the brilliant and intrepid Major G. H. Scott, and Col. V. C. Richmond, responsible for the design of the airship; Mr. M. A. Giblett, of the Meteorological Office, and a familiar figure at British Association meetings, each of whom in his respective sphere was an inspiration to his fellows, have perished with the vessel which was to carry them to Egypt and India in triumph. The vessel itself could have been replaced. The loss of these splendid lives is more than a national calamity: it makes the world poorer. The loss of the airship by itself would, while they lived, have merely spurred them to greater efforts to justify their faith in the future of this type of craft. But it will occasion no surprise if the country as a whole, with this culminating disaster in mind and deprived of the enthusiasm and driving force of these pioneers, will find adequate reasons for refusing to go forward with schemes for further airship construction while the risk to valuable lives is manifestly so great.

Sir Richard Glazebrook, chairman of the Aeronautical Research Committee, in a letter to the *Times* of Oct. 7, pays grateful tribute to the scientific influence and service of several of the men whose loss the nation now deplores. Lord Thomson, he says, has ever been most helpful in the work of the Research Committee: Sir Sefton Brancker's enthusiasm was most infectious, and his interest in problems bearing on civil aviation most stimulating. Col. Richmond was a member of Sir Richard's staff in the Aeronautical Department of the Imperial College some ten years ago, and he was a leading authority on airship construction. Major Scott knew all there was to know about airship navigation, and his experience would have been of great value in the development of airship traffic in the future. Squadron-Leaders Bishop and Rope had both done notable work. During the War, when the rapid gauging of munition parts was of vital importance, Bishop invented improvements in the method which secured greater accuracy and greater speed. Rope is the author of a well-known article on airship lift in the "Dictionary of Applied Physics". Mr. Giblett had devoted himself for some years to meteorological problems bearing on airships, and our knowledge of the motion of the air in gusts and the distribution of 'gustiness' in a wind is largely due to his researches at Cardington. "All these men", adds Sir Richard, "realised in a marked degree that the development of the airship depended on the combination of scientific ability and the experience gained in flight. They gave of their experience freely; they utilised, wisely and wholeheartedly, all we could give them from our stores of mathematical learning and scientific knowledge. And now they are gone; their work will live, and my Committee would wish me, I know, to express their sense of its greatness, their sorrow for our loss."

It is interesting to compare the speeches made by the Prime Minister and other representatives of the British Commonwealth of Nations at the opening session of this Imperial Conference with those made at the corresponding session in 1926. In 1926, the dominant personalities at the Conference were Mr. Baldwin and Mr. Amery, representing Great Britain, and Mr. Bruce, the Prime Minister of Australia, all of whom believe that preferential tariffs are essential for the realisation of Imperial economic unity and prosperity. Nevertheless, the subject of tariffs occupied little of the time of the Conference, other forms of Imperial preference receiving far more consideration, particularly the means by which the various countries of the Empire could most effectively apply their scientific workers and reserves of scientific knowledge to the tasks of developing the vast potential resources of the Empire and combating the diseases afflicting or threatening its peoples, domestic stock, and plant products. As proof of the earnestness of Great Britain in the matter, Mr. Baldwin was able to point to the creation of an Empire Marketing Board with ample funds at its disposal for the furtherance of schemes for marketing Empire products and for the prosecution of research. This approach to the problems confronting the Conference was sufficiently novel and promising to awaken the keen interest of most of the Dominion statesmen present, and encouraged the hope that at future conferences even more time would be given to the consideration of the impacts of science on Imperial affairs.

It is disappointing to find so little indication in the opening speeches that the principal representatives at the present Imperial Conference appreciate the significance of these impacts on our material progress or realise their potentialities as an Imperial consolidating force. Neither Mr. MacDonald nor any of the other Prime Ministers found it necessary to refer to the fact that science has hitherto been applied almost exclusively to solving the urgent and vital problem of production, and that now the governments of the Empire—indeed, all governments—are confronted with a new one, namely, that of re-equipping the machinery of State and reorganising the system of finance so that the peoples of the world can take full advantage of their immensely increased productive capacity, which they owe to the application of science in the production of foodstuffs, essential raw materials, and manufactured goods. It is surprising that Mr. MacDonald did not take advantage of the exceptional opportunity offered him as chairman of this Imperial Conference to open its proceedings with a

survey of the work already done to further Imperial co-operation in various fields. To this he might have added an invitation to the Dominions to co-operate more fully with Great Britain in the task of developing the non-self-governing dependencies of the Crown, a field of work which could provide a magnificent outlet for the energies and initiative of the products of the universities of the Dominions.

FURTHER, Mr. MacDonald might have expressed an opinion on the fruitful suggestion conveyed to him some months ago in a memorandum drawn up by Sir Basil Blackett as the outcome of a series of discussions on Imperial economic co-operation by an authoritative group of politicians, men of science, and financial experts, that an Imperial Economic Body, deriving its authority and its income from the governments of the Empire, should be set up by the Imperial Conference. This body, it was suggested, should have a permanent secretariat similar to that of the Secretariat of the League of Nations, its functions being to deliberate and advise upon all questions affecting the economic and social well-being of the Empire, and to promote efficiency in production and marketing (*a*) by the development of a common service of economic intelligence and investigation and (*b*) by the promotion of co-operation in the application and dissemination of the results of scientific research. This, of course, would involve the new body in the assumption of responsibility for the work of the four existing inter-Imperial bodies, namely, the Imperial Economic Committee (including the Empire Marketing Board), the Imperial Shipping Committee, and the Mechanical Transport Council. The suggestion that there should be such an Imperial Economic Secretariat also has the support of the Empire Economic Union, the research committee of which recently published an illuminating report on the trade relationships and economic position of the various countries of the Empire. Such a permanent secretariat is badly needed. With this continuously working for the furtherance of the ideal of Imperial economic co-operation, and regular yearly meetings of an Imperial Council at which the countries of the Empire were represented, there would be some hope of continuity of policy between successive Imperial conferences.

DR. A. W. HILL, Director of the Royal Botanic Gardens, Kew, in his thoughtful and interesting inaugural sessional address to the students of the School of Pharmacy, delivered on Oct. 1, dealt first with the Doctrine of Signatures which was so widely accepted by herbalists and physicians during the Middle Ages, a doctrine which, while containing much that was fantastic, contributed very materially to the study of plants and the recognition of their medicinal value. According to this ingenious doctrine, every plant bore on some part of it, leaf, stem, seed, etc., some sign or indication of the part of the body diseases of which it would cure, or in its juice a resemblance to one of the four humours, namely, blood, yellow bile, black bile, or phlegm, disorders that it would alleviate: thus the lungwort (*Pulmonaria*), spotted with tubercular scars, was a specific for consumption; the blood-root (*Tormentilla*), which derives its name from the red colour of its roots, was adopted as a cure for the bloody flux; while the bryony, the root of which resembles the foot of a dropsical man, was a remedy for dropsy. Even the great naturalist, John Ray, believed that by the wise dispensation of Providence such species of plants are produced in every country as are good for the diseases prevalent in that country.

DR. HILL wisely recommended the study of the work of early pioneers in botany and medicine, remarking that "we are too apt to think that there is little to be found out by delving into the literature of the past . . . but it is somewhat surprising to find how much the early investigators, herbalists, monks, and others knew of the properties and uses of plants and how much we can learn from their writings". One might add to these very true remarks that much valuable information would doubtless follow from inquiries into the reasons why herbs that had a reputation when the herbs themselves were used lost that reputation when modern preparations were employed. Dr. Hill then proceeded to deal with the importance of studying the physiological varieties of plants and ascertaining in what respects these varieties, though at present botanically indistinguishable, differ in their chemical constituents. The example selected by Dr. Hill was that of *Eucalyptus dives*, the volatile oils of four physiological varieties of which differ enormously in the proportion of piperitone, cineol, and phellandrene which they contain. Mr. Penfold, in remarks quoted by Dr. Hill, says: "I am unacquainted with any evidence which shows the medicinal value of Eucalyptus oils to be due to cineol". "It is only", said Dr. Hill, "by the exercise of the observant faculties and by making deductions therefrom that we are able to make any real contribution to knowledge."

THE Eighth International Congress of the History of Medicine, to which we directed attention in our issue of Aug. 23, p. 292, was held in the Accademia dei Lincei at Rome on Sept. 22–28, under the presidency of Dr. Pietro Capparoni, professor of the history of medicine at Pisa, with Prof. Castiglioni, who occupies the corresponding chair at Padua, and Prof. Bilancioni, of Rome, as vice-presidents. About 230 members were present, from sixteen different countries. The British delegate was Dr. J. D. Rolleston, who also represented the Royal College of Physicians and the Royal Society of Medicine; the Royal College of Surgeons and the University of London were represented by Prof. G. E. Gask; the Society of Apothecaries by Dr. Vincent Dickinson; the University of Manchester by Dr. R. Whitehead; and the Wellcome Medical Historical Museum by Capt. P. J. Johnston-Saint. The most notable figures in the Congress were Prof. Karl Sudhoff, of Leipzig, the doyen of medical historians, and Prof. Georg Sticker, of Würzburg, the leading living writer on the history of epidemiology, who both took an active part in the proceedings.

IN addition to the papers referred to in our previous reference to the International Congress of the History

of Medicine, mention may be made of the following communications: the relations between the Accademia di Cimento and the Royal Society, by Dr. Mosè di Segni; malaria in contemporary poetry from Virgil to Carducci, by Signora Anna Celli, the widow of the eminent malariologist; madder in the history of medicine, by Dr. G. R. Cameron; and the appearance of chlorosis in the sixteenth century, by Dr. Axel Hansen. The receptions included an audience and address by the Pope in the Vatican; visits to the Bibliotheca Casanatense and Bibliotheca Lancisiana, where there was an exhibition of manuscripts, incunabula, and other rare medical works; excursions to Lake Nemi and inspection of Caligula's galley, as well as to Monte Cassino, where a bronze was offered to the monastery in recognition of its services to medical science in the Middle Ages. On his way to and from the meetings, as well as on the rare occasions when he was unable to escape the temptation to play truant, the student of social hygiene could not fail to be impressed by the conspicuous absence of beggars, prostitutes, and drink advertisements in the streets of Rome, which in this respect set an excellent example to those of London, Paris, and other large towns. The next Congress will be held at Bucharest in 1932.

SCOTLAND is soon to possess a Scottish National Trust, which will play in the northern kingdom a part similar to that of the original National Trust, the activities of which are in practice confined to England and Wales; that is to say, it will constitute a body of trustees, governed by a council, to which benefactors may convey lands and properties, and which may from time to time take steps to secure properties in the national interest as funds permit. The Trust will be a registered company, limited by guarantee, with a council or board of control and such other administrative apparatus as its subsequent development may make necessary. Private individuals up to any number may become members of the Trust on payment of an annual subscription of one guinea, to which amount personal liability will be limited. The Trust is to be promoted by the Council of the Association for the Preservation of Rural Scotland, and a provisional council, of which the Duke of Atholl has accepted the presidency, has been formed. The move is a laudable one, but in view of the fact that a Government Committee has been investigating with thoroughness the possibilities of setting aside areas in Great Britain for the people, no harm would have been done had the promoters had the patience to wait for and perhaps benefit by the recommendations and suggestions of that Committee.

DURING the coming winter a course of lectures on "Native Races of the Empire" will be given under the auspices of the Royal Anthropological Institute. The lectures will be popular in character, following in this respect the course given last year on "Early Man". Each lecture will deal with the people of a single area. In addition to giving a general account of the people, the lectures will illustrate the bearing of the study of their culture on the problems of the administration of their affairs under European jurisdiction. The first lecture of the series will be given by Prof. J. L. Myres, president of the Royal Anthropological Institute, on Oct. 15, at 5.30 P.M. He will deal, among other matters, with the general aspect of the relation of anthropological studies to administration, under the title of "Native Races of the Empire: Facts and Problems". The second lecture will be given on Nov. 12, by Mr. A. M. Hocart, on "Spirit Worshippers of the South Seas"; and on Dec. 10, Lord Raglan will lecture on "The Tribes of the Anglo-Egyptian Sudan". Further lectures in the series will be given after Christmas—on Jan. 15, Feb. 10, and Mar. 10. Subjects and speakers will be announced later. The lectures will be given in the Portland Hall of the Regent Street Polytechnic Extension, Little Titchfield Street, Great Portland Street, W. Admission will be free.

THE expedition by submarine across the Arctic Sea suggested some time ago by Sir Hubert Wilkins is now taking definite shape. Science Service, of Washington, D.C., announces that an American submarine, withdrawn from the United States navy, has been acquired and named *Nautilus*. It is a small vessel with a submerged displacement of 566 tons. The cruising radius on the surface is 3000 miles, or with emergency fuel, 5500 miles. It is believed that the vessel, stripped of its fighting equipment, will be able to travel at least 175 miles submerged. Lieut.-Commander S. Danenhower will be in command of the *Nautilus*, and Dr. H. U. Sverdrup, who served six years with the Norwegian *Maud* expedition, will be in charge of the scientific work. The course proposed is from Alaska to Spitsbergen. Dr. Sverdrup believes that during July and August the pack will prove to be so open that the submarine will be able to come to the surface every five miles if necessary. On the other hand, it is hoped that the ship will prove capable of breaking through young ice, the position of which can be ascertained by the intensity of the light under water. Some soundings are to be made throughout the voyage, as well as gravity and magnetic observations. Physical observations on the sea water will be taken at different depths.

THE presidential address of Mr. J. G. Lawn on "Periodical Variations in the Prices of Minerals and Metals" delivered in June to the Institution of Mining and Metallurgy, appears in the July issue of the Institution's *Bulletin*. Variations of prices of minerals is a subject which the professional mining engineer frequently overlooks, as to a large extent it lies outside his normal terms of reference. The price of working a mine must be more than balanced by the price received for its products. Fluctuations in working costs can be more or less allowed for by individual operators, and the mining engineer's experience comes into play very largely either in the budget for such allowance or in devising methods of keeping the figures below an economic danger-mark. But prices of products may be governed by national or international circumstances: they soar or are depressed according to conditions, political and otherwise, over which the average

single company has but little control. Thus, beyond an occasional glance at current figures, usually confined to the metals in which he is specially interested, the professional man gives scant attention to the matter. Mr. Lawn dealt with his subject ably under three heads, the metals as money, the relative prices of metals, and periodical variations in prices of minerals and metals. He showed clearly that knowledge of this economic question is very much the concern of the mining engineer, as its obvious influence on operations at the mines themselves is to-day forced home in practically every undertaking. It is as well in these days of severe industrial depression that we are brought to realise that even an honourable profession may become a fool's paradise if the plain 'bread and butter' facts of life remain long disregarded.

IN the August issue of the *Aeronautical Journal* appears the full report of a lecture given by Dr. J. W. Maccoll on modern aerodynamics research in Germany. The paper is valuable in that it gives a very comprehensive account of the intensive research in aerodynamics that has been conducted in Germany—especially on the problem of turbulence—during the past few years under the inspiration of Prandtl and Kármán. The earlier parts of the paper treat of the boundary layer theory and its application to laminar and turbulent motion, the experimental and theoretical investigations into the origin of these states, and the analysis of the characteristics and inner mechanism of fully developed turbulence. Workers in the subject will find this paper of great value because of the systematic arrangement and exposition of the enormous amount of work in this field that has been conducted in Germany. Incidentally, the essential empiricism of the present German school is very apparent in the nature of the assumptions that are made at each stage where the mathematical difficulties appear too severe.

THE tenth Annual Report of the Non-Ferrous Metals Research Association and the July number of the *Bulletin* of the Association have recently been issued. We have already referred to the finances of the Association and to the new headquarters, where much of the work will in future be concentrated. The experiments on ternary alloys of lead, which have brought about a marked improvement in cable sheathings for positions subject to vibration, such as on railways, have led to further developments in the making of water pipes and lead roofing. Another product of the research work of the Association is the aluminium brass for condenser tubes, and this material is now undergoing tests on a large scale in practice. The Report contains particulars of many other investigations, some of which have been conducted in central laboratories and others in university and other institutions in close touch with the Association. This policy of co-operation has proved to be of great value in the training of research workers, in addition to its immediate results. The information service, which is on an extensive scale, has already served as a model to other organisations, and such reports as that just issued supply adequate proof of the usefulness of the system of research associations under the scheme of the Department of Scientific and Industrial Research, provided that a competent staff can be secured, as in the present instance.

THE growing number of international organisations, more especially in the electrical field, has led the Institution of Electrical Engineers to appoint an International Relations Committee to discuss the question of the best way to co-ordinate British participation in them. The International Electrotechnical Commission (I.E.C.) is the oldest of these bodies and has done admirable work in its somewhat limited field, its specific purpose being to obtain agreement on standardisation questions. At the recent technical sessions of the I.E.C. held at Stockholm, an informal preliminary discussion on this subject was opened by Mr. P. Good, an English delegate. In comparing the other international bodies with the I.E.C., he pointed out that their primary purpose was the exchange of information and experience and the bringing in personal contact of those engaged in similar work in different countries. Recent experiences have shown that congresses of this kind have already reached the stage of being overburdened with papers which receive little attention, and some of them are not up to the standard of, or suitable for, international discussion. There is great need for co-ordination in the international field in order to avoid overlapping of effort. Mr. Good suggested the possibility of changes being made in some of the existing organisations or the merging together of them into a body which should be representative of the electrotechnical industry as a whole throughout the world. It would have the funds to promote continual international exchange of technical information and when necessary it could call conferences. An organisation of this nature would have to be governed by properly formed national committees, each of which would have the responsibility of seeing that the papers contributed by its members were of a standard which justified international consideration.

THE problem of measuring the temperature of the air is much more difficult than would be supposed by anyone who has not attempted it, because of the necessity for eliminating the influence of radiation, which affects the thermometer very readily but the air only in an indirect way. If any kind of self-registering thermometer is to be used, the Stevenson screen has long been the standard method in Great Britain. In that screen a reasonably free circulation of air is secured by the use of louvres, and direct radiation is at the same time prevented from reaching the thermometers; much stress is always laid on the importance of having the screen painted white. In a paper by Barkat Ali (Scientific Note No. 11 of vol. 2 of the "Scientific Notes" of the Indian Meteorological Department) the results of comparative observations made with three teakwood Stevenson screens, painted black, painted white, and unpainted, are summarised. The observations were made at Agra between May 15, 1925, and Feb. 28, 1926, that is to say, during a period including many days with solar radiation of an intensity never

experienced in the British Isles. The results were surprising. In place of the large differences that might have been expected during the daytime between the black and the white screens, even the mean maximum obtained in them differed only by 0·8° F. By grouping the observations to include only the days of little or no cloud and wind the difference was increased only to 1½°F.; the mean of the maximum and minimum was practically identical for all three screens. The observations appear to imply that in the British Isles white paint is almost unnecessary, but since the wood needs protection against the weather and white paint is not expensive, it is obviously preferable to use it, even though a substance like linseed oil might be more lasting and even cheaper; readings made in dark-tinted screens can, however, be accepted as reasonably accurate where figures from a whitened screen are not available, the more so as there are various other more important sources of error in a large proportion of the climatological statistics accumulated by private and official observers in Great Britain.

THE *Eugenics Review* (vol. 22, No. 2) contains a biographical sketch of Mr. Henry Twitchin, a wealthy benefactor of the Eugenics Society, who died on Mar. 19 last, by Major Leonard Darwin. Mr. Twitchin had given the Society £1000 a year for some years, but his bequest will probably have an annual value of more than £3000. He was born in Berkshire from farmer ancestors, and after a training in agriculture he emigrated to Western Australia as a young man and took up sheep-farming. In 1924 he sold his estates, comprising more than a million acres of pastoral leases, and, after thirty-four years in Australia, returned to England. His interest in sheep-breeding early led him to recognise the importance of the principles of heredity as applied to man. Mr. Twitchin was for many years in correspondence with Major Darwin on the subject of eugenics, and his views are summarised in extracts from some of his letters. From 1912 until the day of his death he showed increasing interest in the aims and work of the Eugenics Society.

IT is announced by Science Service of Washington, D.C., that the National Academy of Sciences has accepted a trust fund of £5000 presented by a group of officials of the American Telephone and Telegraph Company in honour of General John J. Carty, vice-president of the Company, who recently retired from active connexion with the scientific research of that body. The John J. Carty Medal and Award for the Advancement of Science which will be supported by this fund may be "either for specific accomplishment in some field of science or for general service in the advancement of fundamental and applied science". It is to be awarded without regard to race, nationality, or creed. The award has been established as a testimonial to General Carty's "noteworthy contributions to the advancement of fundamental and applied science and in appreciation of his great service for many years in developing the art of electrical communication". General Carty is a past president of the American Institute of Electrical Engineers and is well known for his interest in transcontinental and transoceanic telephony.

REFERRING to his obituary notice of Prof. H. W. Wiley, which appeared in NATURE of Sept. 20, Prof. Henry E. Armstrong writes to inform us that his visit to America, when he first met Wiley, was in the summer of 1897, not in 1903.

A COURSE of lectures on "Contraception and Allied Questions"—the first course on this subject to be given in Great Britain—is being delivered in the lecture hall of the Royal Institute of Public Health, 37 Russell Square, London, W.C.1. The first lecture, on Oct. 9, is by Rev. Dr. A. H. Gray, on "Christian Civilisation and Contraception." The subjects dealt with in the course are of special importance at the present time, particularly in view of the memorandum recently prepared by the Ministry of Health for the guidance of local authorities, and also the fact that the medical schools in Great Britain do not provide courses of instruction on the subjects. The course has been specially planned to meet the needs of medical practitioners and senior medical students, and their admission to the lectures is free.

THE following appointments have been made recently by the Secretary of State for the Colonies: *Colonial Agricultural Services*: Mr. C. A. Thorold, to be assistant mycologist, Kenya; Mr. V. Dawson, to be assistant agricultural instructor, Federated Malay States; Mr. H. D. Leighton, to be agricultural field officer, Federated Malay States; Mr. B. A. Lowe, to be assistant botanist, Federated Malay States; Mr. J. P. Maule, Mr. S. D. Ross, and Mr. J. West, to be superintendents of agriculture, Nigeria; Mr. J. R. Curry and Mr. N. R. Fuggles, to be district agricultural officers, Tanganyika Territory; Mr. H. M. Lloyd, to be entomologist, Tsetse Research, Tanganyika Territory; Mr. H. L. G. Milne, to be agricultural officer, Uganda. *Geological Survey*: Major N. R. Junner, director of Geological Survey, Sierra Leone, to be director of Geological Survey, Gold Coast. *Colonial Forest Services*: Mr. R. C. Barnard, to be assistant conservator of forests, Federated Malay States; Mr. T. F. Betts and Mr. J. H. Mackay, to be assistant conservators of forests, Nigeria; Mr. W. J. Eggeling, to be assistant conservator of forests, Uganda.

THE Board of Control has issued a *Circular* (No. 745) and *Memorandum* on the Mental Treatment Act, 1930, reviewing the provisions of this Act, which comes into operation on Jan. 1, 1931. The Act provides for various alterations in administration and embodies the following principles: (1) The preventive treatment of incipient mental illness by the provision of out-patient clinics and extended facilities for voluntary treatment. (2) A further advance in assimilating the treatment of mental illness to that of other forms of illness, (*a*) by provisions under which certain cases may be temporarily placed under care and treatment without 'certification', and (*b*) by the opportunities afforded of associating the general hospitals (municipal and voluntary) in the treatment of mental illness. (3) Extended provision for aftercare and for systematised research into mental illness. (4) Dissociation of the treatment of mental illness from

the poor law. (5) Various important alterations in terminology reflecting the more enlightened view now taken in regard to mental illness.

THE publication of "A Survey of Scottish Coking and Furnace Coals" (Physical and Chemical Survey of National Coal Resources, Paper No. 15. London: H.M.S.O., 4*s*. net), by T. Gray, T. H. P. Heriot, and W. J. S. Killing, is a reminder of the sort of difficulties, all too common during the War, which might have been avoided by the more scientific study of national raw materials. In 1916, when the need for increasing the supply of steel became urgent, it was found necessary to investigate the supplies of coking and splint coals available in Scotland for the manufacture of pig iron. Prof. T. Gray, of the Royal Technical College, Glasgow, undertook the responsibility for this survey, which has now been published in response to numerous requests. It contains reports on 367 samples from all the Scottish coalfields, and records the suggestion for improving the coke from such coals by increased rate of carbonisation, now generally adopted, by the use of higher temperatures and narrower ovens.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior engineering assistant (Grade G) and an engineering assistant (Grade F) in the Borough Engineer's Department, County Borough of West Ham—The Borough Engineer, Town Hall, West Ham, E.15 (Oct. 20). Two veterinary surgeons, one with bacteriological and pathological knowledge and experience of laboratory technique, and one for meat inspection work, under the New Zealand Government—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 21). A part-time radiologist at the Selly Oak Hospital—The Medical Superintendent, Selly Oak Hospital, Birmingham (Oct. 22). An assistant radiologist at the Dreadnought Hospital, Greenwich—The Secretary, Dreadnought Hospital, Greenwich, S.E. (Oct. 27). A deputy director of the laboratories of the Public Health Department, Cairo, and a first bacteriologist in the laboratories of the Public Health Department, Cairo—The Under-Secretary of State, Department of Public Health, Cairo (Oct. 30). A geneticist in the Agricultural Department of Jamaica for work, partly, on the breeding of bananas immune from the Panama disease—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Oct. 31). A John Harling fellow in physics in the University of Manchester—The Registrar, The University, Manchester (Nov. 1). A lecturer in civil engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 1). Assistant surveyors in the Admiralty and in the Air Ministry—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Jan. 22). A director of the Natal Museum—The Secretary to the Board of Trustees, Natal Museum, Pietermaritzburg, South Africa (Jan. 31). An assistant in the Pathological Laboratory of the Cancer Research Department, Bristol Royal Infirmary—The Secretary and House Governor, Royal Infirmary, Bristol.

## Our Astronomical Column.

**New Comet or Asteroid?**—U.A.I. Circ. No. 299 announces that M. E. Delporte has detected an interesting object (either planet or comet) on a plate taken at Uccle Observatory in the following position:

| U.T. 1930. | R.A., 1925·0. | S. Decl. 1925·0. | Mag. |
|---|---|---|---|
| Sept. 29d 0h 7m 6s | 23h 41·8m | 2° 30·4′ | 12·0 |

The daily motion is −1m 43s, N. 11′ 56″. This is unusually large for a minor planet, so if the object is a planet it has probably an interesting orbit not very far outside that of the earth. The object is well placed for observation, being not far from opposition.

**Occultations at the Union Observatory, Johannesburg.**—In recent years there has been a remarkable awakening to the value of occultations of stars by the moon for finding the errors of the lunar tables. One great advantage is that the points on the moon's limb are much more widely distributed than in the case of meridian observations; in the latter an elevated or depressed region on the limb may affect observations systematically. Dr. Innes was one of the first to inspire the new campaign, and the work has been energetically carried on at Johannesburg since his retirement. *Circ.* No. 32 of the Observatory (May 19, 1930) contains the observations and reductions (by W. M. Worssell) of 152 occultations observed in 1929; of these, 126 were observed between new and full moon, the remainder after full. The method of reduction suggested by Prof. Brown was to apply a constant mean correction to the moon's mean longitude, this being determined each year by the results of preceding years; the smallness of the residuals after applying this correction gives striking evidence of the excellence both of the observations and of Brown's lunar tables, once the mean error has been taken out. At Johannesburg, Brown's method is varied slightly; instead of applying a constant to the moon's mean longitude, one is applied to the times used for interpolating the moon's co-ordinates. Thus 12·7 sec. was added to the times for the first half of 1929 and 10·9 sec. for the second half. This has the advantage of correcting all three co-ordinates, longitude, latitude, and parallax, by a single operation.

**Observations of Meteors in Japan.**—*Bulletins* No. 173 and 174 of the Kwasan Observatory, Kyoto, announce that numerous meteors, presumably associated with comet 1930*d* (Schwassmann-Wachmann) were observed, chiefly by Mr. Nakamura, on ten nights extending from May 24 to June 19. The radiant moved during this period from R.A. 15h 19m, N. Decl. 43° to R.A. 16h 19m, N. Decl. 39°. Parabolic orbits were deduced for the meteors; the node varied with the longitude of the earth, but the inclination was nearly constant, about 27°, the argument of perihelion about 201°, and the perihelion distance close to unity. The cometary perihelion was a few millions of miles outside the earth's orbit, so the meteors are considerably scattered.

The same *Bulletins* announce that Prof. Issei Yamamoto is preparing a general catalogue of comets, which he hopes to publish next year. It will contain all comets for which orbits have been computed, and notes upon those for which the data are insufficient to deduce orbits.

## Research Items.

**The Pyramids.**—In *Ancient Egypt* for June, Sir Flinders Petrie discusses the constructional difficulties in building the pyramids and offers some suggestions as to the means adopted by the ancient Egyptians in overcoming them. Their construction involved earth banking on an enormous scale and the employment of levies of thousands of men moving quickly by main force. The lever and roller were practically the only appliances used. The Great Pyramid shows no trace of enlargement and the passage system demands almost the full size from the first. The earth ramp needed for its construction must have been of great size, almost of the volume of the pyramid itself; otherwise the final slope would have been too steep, while a full front was necessary to get up the 50,000 blocks required for each of the lower courses; also, to maintain the sides of an earth bank to the height of 400 feet would entail a base as wide. The bank was heightened as the work proceeded by waves of stone-work and earth-work alternatively moving up the bank. The height of the ramp is a difficult question. It cannot have been carried to the full height of the pyramid. Probably earth bank and brick facing rose to not more than 300 feet. At this level the face would be 150 feet wide. Above this the raising must have depended on a support of stone in the form of a stone ramp with a platform zig-zagging up the side. A platform and ramp of 20 feet each would suffice for getting up the stone for the upper courses. It would scarcely be practicable to carry a regular ramp higher than 12 feet below the capstone. The last six or eight courses would be raised by direct levering in a safety pit. Lastly, the capstone itself would be levered up on stone blocking outside the completed faces, on a sort of pedestal of blocks, until it reached its proper level. From a platform thus outside the pyramid face it would be slid forward on rollers until finally in place. The staging of stone would then be taken off and the top courses trimmed down to the slope, about four feet at a time.

**Pedigrees of Hereditary Disease.**—In a paper entitled "Some Pedigrees of Hereditary Disease" (*Annals of Eugenics*, April 1930), Dr. Julia Bell makes a contribution to the records of polydactylism and syndactylism, and the association of blue sclerotics with fragility of bone. Among eight families the pedigrees show the transmission of the former defects through several generations. The data are not considered sufficient to permit any conclusion being drawn as to the sex incidence, but it is clear that such digital anomalies varied greatly in the intensity and mode of their inheritance, while a considerable number of cases investigated yielded no evidence of any familial incidence. Dr. Bell refers to the fact that while the association of polydactylism with retinitis pigmentosa and hypopituitarism is rare, this syndrome is found in all affected members of the family when the association does occur, and that the parents have no reason to suspect the existence in themselves of any hereditary taint. In the case of blue sclerotics, Dr. Bell points out that the highest incidence is to be found in females, which is an uncommon observation in the transmission of hereditary defects. The thin condition of the sclerotic which is the actual cause of the characteristic colour may occur without any associated anomaly of bone, but if fragilitas ossium is exhibited by any member of a family, that individual will invariably show the accompanying anomaly in the eye.

**Salt-loving Beetles of the North.**—Dr. Hans v. Lengerken has described the maritime and submaritime beetles of the shores of the North Sea and Baltic ("Die Tierwelt der Nord- und Ostsee". Begrundet von G. Grimpe und E. Wagler. Lieferung xvi. Teil xi.e1: "Halophile und Halobionte Coleoptera". Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929). His large work recently published, "Die Salzkäfer der Nord- und Ostseeküste", shows Dr. Lengerken to be the principal authority on the subject and chiefly owing to his work the beetles of these coasts are thoroughly known. A surprising number love the salty districts, and, although not usually actually living in the sea, for the whole of their life they may be, and in many cases must be, in the proximity of salt water. Only one truly marine species is to be found in these regions, and this is *Haemonia* (*Macroplea*) *mutica* F. (Chrysomel.); the remainder live on the coasts and are either dependent on the presence of salt water in the near neighbourhood, 'halobionte', or live both in salty and un-salty districts, 'halophile'. Taking both together, there are 111 species recorded from the shores of the North Sea and Baltic. Most of these are predatory in their habits. After a short introduction, a table of distribution is given and the systematic portion follows in which the genera are diagnosed and the species recorded, with notes on their habitat and sometimes on their habits and life-histories. There are only nine figures in all, which is to be regretted, as those given are very good.

**Fishes from the *Albatross* Expedition.**—Mr. Henry W. Fowler and Mr. Barton A. Bean have finished a third instalment of the report on the fishes collected by the United States Bureau of Fisheries steamer *Albatross* entitled "The Fishes of the Families Amiidæ, Chaudidæ, Duleidæ, and Serranidæ, obtained by the United States Bureau of Fisheries Steamer *Albatross* in 1907 to 1910, chiefly in the Philippine Islands and Adjacent Seas" (Contributions to the Biology of the Philippine Archipelago and adjacent regions. Smithsonian Institution. *U.S. National Mus. Bull.* 100, Vol. 10. 1930). This is the first report on the percoid fishes, limited to the more typical perchlike families, particularly the Amiidæ and Serranidæ, which are much the most numerous both in species and individuals. It has been known for some time that in certain species of the Amiidæ the males carry the eggs in their mouths. The authors now show that this condition is more or less general. The male at the breeding season can be recognised easily by its swollen chin, the eggs being carried about packed in a dense mass. Interesting illustrations are given of the heads of some of these males carrying eggs. There are also good figures of some of the more important variations in fishes belonging to the other families described. The report deals with more than 150 species and occupies 334 pages.

**Production of Hybrid Apples.**—In his public lecture delivered during the British Association meeting at Bristol on Sept. 4, Sir Daniel Hall essayed, with considerable success, the difficult task of making some of the interesting genetic work of the John Innes Horticultural Research Institute intelligible to the 'man in the street'. Cultivated strains of apples, unlike many kinds of orchard fruit, are relatively self-fertile within the strain, but he showed that the proportion of fruit set per blossom, and, still more, the number of fertile seeds per fruit, is markedly lower in such well-known varieties as Ribston Pippin, Blenheim Orange, and Bramley Seedling. In these varieties, less than 30 per cent of the pollen is viable and they are particularly deficient as male parents. These varieties of

apples have now been shown to be triploid varieties with 51 chromosomes, instead of the 34, with 17 in each sex cell, characteristic of the majority of the apples. With this discovery the puzzle is rather the relatively large amount of fertile seed obtained from crosses using the sex cells of these varieties. The work of Dr. C. D. Darlington and Mr. Moffat seems to have shown a reason for this; whilst 17 chromosomes is the basic number for the genus *Malus*, as for all the genera of the Pomoideæ, in many of the Rosaceæ the basic number is 7. The relative fertility of these strains with 51 chromosomes may be explained by the fact that this basic number 7 is probably built into the genetic constitution of the apple, so that on segregation of the chromosomes, in the formation of the sex cells, whilst it is unlikely that two working sets of 17 would be separated from 51, there is the possibility of working combinations of sevens with some additional chromosomes that can be carried without disorganisation of the machinery of inheritance. In the circumstances, then, it is possible that the history of the Cox's Orange Pippin is correctly recorded; it is stated to be derived from the Ribston Pippin, but it is intelligible that successful new strains from these well-known varieties have usually been sought in vain.

**Wheat-Rye Hybrids.**—Meister succeeded several years ago in obtaining fertile hybrids between wheat ($2n = 42$ chromosomes) and rye ($2n = 14$). More recently Levitsky and Benetzkaia (*Proc. U.S.S.R. Congress in Genetics, Leningrad*, vol. 2, p. 345) have examined a number of these plants in the $F_4$, $F_5$, and $F_6$ generations and find the somatic number of chromosomes to be 56: that is, the hybrids are amphidiploid, their chromosome number being the sum of the somatic numbers in the parent species. In the megaspore formation of the $F_1$ plants, it was observed that the 28 chromosomes do not pair but split, from which it is inferred that eggs with 56 chromosomes are formed and develop without fertilisation. The $F_1$ hybrids have always been observed to produce sterile pollen. In the later (octoploid) hybrids the pollen meiosis is frequently normal, but also shows frequent lagging and scattered chromosomes. Since the later hybrids examined all had 56 chromosomes, it is believed that gametes with extra chromosomes either fail to function or else lose them in the pollen tube formation. This doubling of the chromosomes in a sterile hybrid to produce a fertile form which breeds true is thus similar in essentials to the *Triticum-Ægilops* hybrid, *Primula kewensis*, *Nicotiana glutinosa* × *N. Tabacum* and other recent cases. Such instances offer a suggestion as to how certain genera of plants with increased chromosome number may have arisen in the past.

**Ice in the North Atlantic.**—The report for 1929 of the International Ice Observation Patrol Service in the North Atlantic Ocean (*U.S. Coastguard Bulletin*, No. 18) contains much interesting matter besides the record of the courses of the patrol boats and the distribution of ice. Perhaps the most significant result of several years' work is the admission that, so far at least, no satisfactory basis for the prediction of ice has been found in surface isotherms. The charts are regularly made, but they cannot be accepted as wholly reliable guides. The cold water from the melting berg appears at times to fall below warmer and lighter surface layers and thus the surface isotherms may be misleading. The problem is, however, being further studied in the hope of reaching more satisfactory results. The construction of dynamic current maps promises to be more useful, but takes more time. It is further noted that no practical way of destroying ice has yet been found. Mechanical means like blasting and mining give little likelihood of success, but it is noted that the use of thermite is rather more hopeful, were it not for the grave difficulties of placing the charge in the heart of the bergs.

**Forbidden Transitions in Alkali Spectra.**—Lines forbidden by the selection rule for azimuthal quantum numbers ($\Delta k = \pm 1$) have been observed in the absorption spectra of alkali metals under conditions which apparently preclude the usual explanation of this effect as due to the presence of external or ionic fields. Since it is now also recognised that the selection rule represents only approximately the content of the quantum theory of a transition, it is natural to connect these two facts, and to find from a stricter theoretical treatment of the problem the intensity to be expected for a 'forbidden' line. An analysis appropriate to the alkali metals has been developed by A. F. Stevenson in a paper in the August issue of the *Proceedings of the Royal Society*, on quadripole radiation, and by the application of the wave-mechanical descriptions of these atoms which have been obtained by Hartree's method, numerical values have been calculated in a number of cases for the theoretical ratios of certain forbidden lines and normal lines. The ratio for all four alkali metals in the case of the $1S - 3D$ and $1S - 2P$ lines should be about $2 \times 10^{-6}$, whereas the experimental numbers, which are available only for potassium and rubidium, range from about one-half to one hundred times this, which is taken to represent a fairly satisfactory agreement in the circumstances. Other experimental evidence for the existence of quadripole radiation has also been found recently by R. Frerichs and J. S. Campbell, from the study of the transverse Zeeman effect for the auroral green line of oxygen (*Physical Review*, vol. 36, p. 152).

**Restoration of Ancient Bronzes.**—The pamphlet with this title, published as *Museum Technique Series* No. 3 (Chicago, 1930) by the Field Museum of Natural History, contains an account by H. W. Nichols of the electrolytic process of restoration and the cure of malignant patina. The electrolytic process was devised by Prof. C. G. Fink at Columbia University. Very detailed directions are given and the pamphlet is illustrated with diagrams of apparatus and with plates showing objects before and after treatment.

**The Acetylene Molecule.**—The absorption spectrum of acetylene contains a number of bands arising from combined vibration and rotation of the molecule, which are in the neighbourhood of 8000 A. and so accessible to infra-red photography. Two investigations of these, which lead to a fairly complete description of the molecule, are reported in the issue of the *Zeitschrift für Physik* for Aug. 20. The first, by Prof. Mecke and K. Hedfeld, deals with the structure of the bands, and shows that the arrangement of the atoms in the molecule is linear and that if the normal separation of the atoms in the C-H group is 1·08 A., as in methane, that of the two carbon nuclei (C≡C) is 1·19 A. The distance between the carbon atoms is less than in diamond (1·54 A.) and in the diatomic carbon molecule responsible for the Swan bands (1·31 A.). The second paper, by Prof. Mecke and Dr. Childs, gives the results of a photometric analysis of the band at 7887 A. The course of the intensity changes through an absorption band furnishes considerable additional information about the structure of a molecule, and in this case is consistent with the conclusions that the electronic state concerned is that denoted by the symbol $^1\Sigma$, and that the nuclei of the carbon atoms are without spin, whilst those of the hydrogen atoms have a spin of magnitude $\frac{1}{2}$ in quantum units.

## Folk and Open-air Museums.*

THOUGH the expression 'folk museum' is loosely used, it is generally understood, like 'folk-lore', to relate to the ordinary people, the rank and file of the population, the labourers, the artisans, the craftsmen, as opposed to the ruling class. Such collections of indigenous products have great historical value. They deserve to be regarded as almost the only means of preserving visible records of the national characteristics. The humbler the art or the handicraft, the more important it is from this point of view.

In England it is only recently that the regrettable disappearance of the outward and visible signs of the inner history of the people has been fully realised, and consequently it is only recently, and owing to the very rapid growth of local museums, that systematic attempts have been made and are being made to preserve them. The example for this systematic effort was set in Sweden by Dr. Arthur Hazelius, the founder of the Nordiska Museum, which is now one of the glories of Stockholm. This great scheme has been an inspiration for all subsequent attempts to illustrate fully the life of past ages.

It is important, however, to make a clear distinction between two quite different things, although they are adjacent and form part of one scheme in Stockholm. The first is the 'open-air museum' of the Skansen type, in which are re-erected the primitive dwellings, huts, cottages, workshops, windmills, bakehouses, ancient churches, and so on, that would otherwise have been destroyed or converted to other uses; and in these are generally placed the furniture, the appliances, and the decorations that belong to them. The second is the 'folk museum', which contains materials illustrating bygone life and thought at different periods or in different districts of the country; but these materials are not placed in their proper setting, they are brought together and exhibited according to purpose or material, and generally displayed in museum cases in such a sequence as either to compare the customs and handicrafts of one district with those of another, or to illustrate the development of an art or an industry. The open-air museum and the folk museum supplement each other.

There is, in addition, another sort of collection often included under the name 'folk museum', namely, the old house preserved in its original form and in its original place, and containing a display of contemporary furniture and household equipment. There is yet another type of dwelling, namely, the old house or cottage preserved in its primitive simplicity so as to present the appearance of an inhabited dwelling without anything of the museum about it; such is Ann Hathaway's Cottage. It is of such buildings that an 'open-air museum' partly consists.

Let us then confine the term 'open-air museum', for lack of a better, to the Skansen type, 'folk museum' to the Nordiska type, and let us further distinguish between the 'period museum', an old house filled with contemporary exhibits, and the 'period house' or 'period cottage', which has no museum exhibits but reproduces domestic life.

Finally there is the 'period room', either an original transported from a house which has been destroyed, or a facsimile, in which an attempt is made to reproduce the conditions of life, whether in a mansion or in a cottage. Such rooms generally constitute a separate exhibit in a museum.

* Abridged from a paper contributed by Sir Henry Miers, F.R.S., to a discussion on "A Proposed National Folk Museum", in Section H of the British Association at Bristol on Sept. 4.

### State of Affairs in the British Isles.

1. *Open-air Museums.*—In 1912 an attempt was made by a group of influential persons to press the advantages of the Crystal Palace grounds as an ideal site for such an open-air exhibit of a national character. Possibilities for local exhibits of this type have been considered, but nothing has materialised.

Recently the Report of the Royal Commission on National Museums and Galleries has considered the subject from the national aspect and has definitely recommended that a national open-air museum should be established in London; two appropriate sites mentioned are the Botanic Gardens in Regent's Park and the grounds of Chiswick House.

The question has since been taken up by a joint committee initiated by the Royal Anthropological Institute and containing representatives of the Royal Society, the Royal Society of Arts, the Museums Association, and the British Association. This committee has unanimously recommended the Botanic Gardens site as the most suitable, and has approached the Government departments concerned, urging that early action should be taken.

2. *Folk Museums.*—Institutions wholly devoted to this subject, like the Nordiska Museum, are also unknown in the British Isles. The fine collection of peasant arts made by the late Master of the Charterhouse is now an annexe to the Educational Museum at Haslemere and is mainly concerned with northern Europe.

3. *Period Museums.*—Of these we have a considerable number, but comparatively few of them relate to the life of humbler folk. I may instance the Priest House at West Hoathly, the Ancient House at Thetford, the Greenland Fishery at King's Lynn, as typical examples.

4. *Period Cottages.*—As a good example may be mentioned Ann Hathaway's Cottage, but very few cottage-dwellings have been preserved free from the museum taint: most of them contain showcases.

5. *Period Rooms.*—Most of these again, as at Norwich and elsewhere, are typical of the life of wealthy and cultured folk. In the National Museum at Cardiff, in the Museums at Salisbury, St. Albans, and perhaps elsewhere, attempts have been made to reconstruct a kitchen or some living-room with its appropriate furniture and utensils.

6. *Folk (Museum) Exhibits.*—Of these there are abundant examples, rich in valuable material gathered together either as local 'bygones' or placed among ethnographical collections. Conspicuous are the Pitt-Rivers Museums at Farnham and Oxford, the collections at Huddersfield and at Hull, and many of the national and larger provincial museums, including also such local collections as those at Bedford, Luton, Newark, Bolton (Hall-i'-th'-Wood), Worthing, Lancaster.

Finally, some illustrations of the life of craftsmen may be gleaned from museums which illustrate special pursuits or handicrafts; such are, however, extremely rare in Great Britain, and almost the only one which aims at something like completeness is the Museum of Fisheries and Shipping at Hull.

From this short survey it is clear that there is a vast amount of material from which the life, arts, industries, and customs of the people might be illustrated, but it is buried in other collections. It is equally clear that the real need in Great Britain is for an English or British folk museum associated with an open-air museum.

STATE OF AFFAIRS IN FOREIGN COUNTRIES.

1. *Open-air Museums.*

*Sweden.*—There are museums of the Skansen type in Sweden not only at Stockholm but also in many other parts of the country. There are no less than 200 open-air collections in Sweden alone. Skansen itself contains 117 separate buildings, records 700,000 visitors in a year, and occupies 60 acres.

Sweden also possesses a number of quite small village enterprises, where a field or small group of cottages have been set aside for this purpose. One of these at Bunge, started in 1907, has since become an open-air museum of considerable importance. A special feature of this museum is the ancient burial-ground, showing various methods of burial and types of burial-stones dating from the time of the Vikings.

*Norway.*—There is at Oslo the Norsk Museum, which was opened in 1902 and now covers an area of 35 acres, upon which are re-erected old farm-houses of different periods, and an attempt is made to re-create old streets with houses that have disappeared or are fast disappearing. At Lillehammer there is the Sandvig Collection, which contains 75 ancient buildings.

*Denmark.*—At Aarhus there is Den Gamle By (The Old Town), which was started about sixteen years ago by the re-erection of a Burgomaster's house and has since grown to a considerable size.

*Finland.*—At Helsingfors, in the Isle of Folesön, there is a large museum, covering an area of 25 acres, which was founded in 1909; this consists of more than thirty buildings of various types and periods.

*Holland.*—The Nederlandsch Openluchtmuseum at Arnhem consists of 20 buildings, covering an area of 75 acres; this was opened in 1918.

*Rumania.*—At Cluj an excellent example of an open-air museum is being formed with the object of exhibiting the typical peasant culture of the Rumanians and other nationalities in Rumania, by means of their characteristic peasant buildings and occupations. The collections will consist of typical houses brought from each district, and in each of these houses a family from the same district will live to show the type, costume, typical customs, and occupations. In addition to the typical original buildings, it is intended to erect an open-air theatre for the purpose of peasant festivals, and so on.

2. *Folk Museums.*—Museums of this type similar to the Nordiska Museum at Stockholm, though many of them are on a small scale, exist in many other places. Examples are the Museum at Karlskrona in Blekinge, Sweden, and the Engadine Museum at St. Moritz.

CONCLUSION.

It will be seen from this how late we are in any systematic endeavour to preserve and accumulate such illustrations of peasant and artisan life in Great Britain. The folk museum should undoubtedly, where possible, be associated with and supplementary to the open-air museum. It is deplorable that so many old buildings and other survivals from past times have been irrevocably lost in recent years. But the national conscience is obviously awakening to the value of such things, and determined efforts are now being made in many quarters not only to preserve the amenities of the countryside but also to conserve the old houses and cottages which are in danger of destruction. But in too many instances the advance of town building and the alteration of the countryside threaten the actual existence of many a cottage, wind-mill, forge, or other relic of the past which might be saved and re-erected in an open-air museum. Here again, where these can be retained in their own district, that should be done, and for this purpose it is to be hoped that many localities will follow the Swedish example and preserve and maintain such structures in a local enclosure. The institution of a national enclosure should not in the least interfere with such local efforts, but should serve as an example and inspiration to towns and villages all over the country.

## The International Union of Geodesy and Geophysics.

THE fourth meeting of the International Union of Geodesy and Geophysics was held at Stockholm on Aug. 15–23, though the Section of Geodesy found it necessary to begin three days earlier in order to get through a long programme of work. The meeting was very well attended, representatives of thirty countries being present and numbering more than two hundred. A number of other scientific men attended by invitation, among whom were Dr. Linke, of the Geophysical Institute at Frankfurt; Dr. E. Kohlschülter, of the Geodetic Institute at Potsdam; Dr. R. Schreiter, of Freiburg; and Dr. V. Conrad and Dr. Hopffner, of Vienna.

The opening meeting was held on Friday, Aug. 15, in the Concert Hall, where Dr. E. Trygger, the Chancellor of the Universities and chairman of the Swedish National Committee, welcomed the delegates. M. Ch. Lallemand, the president of the Union, replied and expressed the thanks of the delegates for the excellent arrangements which had been made for their comfort. The other meetings of the Union, as well as those of the Sections, were held in the Parliament House, where ample accommodation was available for all.

In the Section of Geodesy, reports were presented by the delegates of the various countries on the progress made in geodetic work since the last meeting of the Union in Prague in 1927, and a number of special points were discussed. These will be published in the *Bulletin* and the *Memoirs* of the Section in due course. Much interest was taken in the account which Dr. Vening Meinesz gave of his recent determinations of gravity at sea, made from a submarine in the neighbourhood of Java, in the Pacific Ocean, and elsewhere. A very interesting discussion took place, and a strong recommendation that work of this character should be undertaken in the Bay of Bengal and other eastern waters was approved, and was later adopted by the General Assembly of the Union.

The death of Prof. H. H. Turner, who was taken ill as he was about to deliver his address as president of the Section of Seismology, cast a gloom over its meetings, but nevertheless a large amount of useful work was done. This Section, as well as that of Geodesy, both of which have to discuss and publish a large collection of data that would not otherwise be readily available to international workers, find their resources far from adequate, and Prof. Turner's address brought the urgent needs of the Section in this respect before the delegates. The work which is being done at Oxford, as well as that under Prof. E. Rothé at Strasbourg, is in need of a fuller measure of support, and resolutions to this effect were adopted by the Section. No successor to Prof. Turner was appointed, but the vice-president, Prof. E. Oddone, was authorised to act as president for the time being.

Owing to illness, Dr. L. A. Bauer, the president of the Section of Terrestrial Magnetism and Electricity, was not present at Stockholm, but his place was taken during the meeting by the vice-president, Prof. Carlheim-Gryllenskold. Dr. J. A. Fleming, of the Department of Terrestrial Magnetism, Washington, was elected president of the Section for the coming period. An interesting series of communications were presented to the Section, in one of which the magnetic work of the international stations during the Polar Year was discussed. It was decided to publish an auroral atlas as soon as the material could be selected and brought together.

The Section of Meteorology had before it a large amount of scientific work in the form of reports and communications. The plans for the work to be undertaken during the Polar Year at the international stations were discussed. This proposal, under which a number of countries have agreed to maintain for twelve months a chain of observing stations in the neighbourhood of the Arctic Circle, and also in south polar regions, was warmly supported as being certain to provide a mass of information of the greatest value and practical importance to meteorology. Dr. Axel Wallen, director of the Meteorological and Hydrographical Service of Sweden, was elected president of the Section in succession to Sir Napier Shaw.

In the Section of Oceanography, Prof. M. Knudsen was elected president in place of Prof. Odon de Buén, who has retired.

In addition to the scientific subjects which were discussed at the meeting of the various sections, the General Assembly of the Unon had before it on this occasion the revision of its statutes. These were adoped eleven years ago at Brussels, when the International Research Council and four of the Unions related to it were formed. It was then resolved that the statutes there approved should come up for revision after twelve years, when experience would have shown what modification of them was desirable. At its last meeting, in 1928, the General Assembly of the International Research Council appointed a committee to consider what modifications should be introduced into its statutes, and the draft statutes which the committee prepared were adopted in July last by the Executive Committee of the Council and recommended to the General Assembly for approval at its meeting in July 1931.

The alterations which have been proposed are in the direction of giving as much freedom as possible to the Unions to arrange their own affairs, since these bodies have grown to be active organisations for scientific co-operation. This will necessitate corresponding changes in the statutes of the different Unions, and the consideration of these at Stockholm occupied the greater part of two days. The procedure for the admission of new members was laid down, and greater freedom was given to the Sections dealing with Geodesy, Seismology, Meteorology, Terrestrial Magnetism, Oceanography, Volcanology, and Hydrology to arrange their activities. It was also agreed that they should in future be termed International Associations. An important decision was that the president of the Union should not in future hold office for a longer period than from one meeting of the General Assembly to the next, and that he should not be immediately eligible for re-election. This should assist in maintaining the international character of the organisation. It may be remarked that the same rule is already operative in six out of the seven other International Unions.

Very ample arrangements were made at Stockholm whereby the delegates might visit all the technical institutions in the city which were related to the work of the Conference, and special visits were made to the offices of the Geodetic Institute, the Observatory, the Geological Survey, the Meteorological and Hydrographical Service, and others, as well as an exhibition of instruments, etc., at the house of the Mining Corporation.

Besides the work done in the sessions of the various committees, much valuable information is interchanged by delegates at the social gatherings which take place at other times, and Swedish hospitality provided a number of occasions at which the guests could discuss matters of common interest. The City Council gave a banquet in the magnificent City Hall early in the week, and the Organising Committee invited the delegates to a luncheon so that they might make the acquaintance of each other before the work of the Conference commenced, and also to a dinner, which brought the social part of the proceedings to a close. The delegates were received at the Royal Palace by H.H. the Crown Prince and the Crown Princess in the afternoon of one of the days, and on one evening a gala performance of "Aida" was given at the Opera House. One whole day was devoted to a visit to the City and the University of Uppsala.

Those delegates who were able to remain in Sweden after the meeting at Stockholm was over were able to choose between an excursion through southern Sweden and another in the northern districts of the country. The latter was of special interest for the mining and geological information which it provided. The director of the Geological Survey took charge of it and those who were able to take part enjoyed exceptional opportunities for gaining first-hand knowledge of the active development which is taking place in this part of the country.

The next meeting of the International Association of Geodesy and Geophysics will be held at Lisbon in the early autumn of 1933.

## The Association of Special Libraries and Information Bureaux.

IN September 1927, at Hoddesden, a conference was held of scientific and business men in many departments of human activity, to discuss the problem connected with the collection, treatment, and dissemination of information. They had no intention of forming a permanent association, but the pressing need for the examination of these problems forced the conference to organise itself. The objects of the Association so formed are: To examine, foster, and co-ordinate the activities of research organisations, special libraries, information bureaux, and similar sources; to act as a directing agency to these sources; to develop the usefulness and efficiency of special libraries; to promote, whether by conferences, meetings, or other means, the wider dissemination and the systematic collection and use of information; and to encourage, by co-operative means, the prevention of waste due to the unnecessary duplication of the work of those engaged in research and allied results. The Association has compiled a very valuable Directory of Sources of Information, and set up an Inquiry Bureau and a Panel of Translators, expert in subject as well as language.

Recently, as the result of long consideration, the Association has decided, in the interest of the more efficient indexing of literature, to become the advocate of a particular classification scheme in order to secure uniformity of method. The special committee appointed to consider the matter came to the unanimous conclusion that the Association should adopt

the Uinversal Decimal Classification; and, as the result of this decision, a Joint Committee with the British Society for International Bibliography has been set up.

The annual conference of the Association of Special Libraries and Information Bureaux has already become an institution to which members look forward with pleasure as a means of discussing their problems with others having the same or different points of view. It is almost impossible for anyone interested in the collection, supply, or use of information to attend one of these meetings without taking away some new idea, or making some personal contact of value.

The seventh conference, on Sept. 19-21 last, at New College, Oxford, was not less interesting or helpful. In his presidential address, Mr. H. T. Tizard referred to the multiplication of books and the need to develop methods by which people can get access to the information they contain. He quoted Dr. Johnson's dictum that "It is indeed culpable to load libraries with superfluous books", but pointed out that the difficulty is to decide which are superfluous. Readers of the *Journal of the Chemical Society* might agree off-hand that nine-tenths of its contents were superfluous, but the digest of the opinions of each fellow, asked separately what tenth he would like to keep, would probably endorse the wisdom of the Publication Committee in retaining the whole. We must make up our minds that the volume of recorded knowledge will continue to swell at an ever-increasing rate, and address ourselves more eagerly than we have in the past to making better use of it. There may be nine-and-twenty right ways of indexing. But the world does not really want more than one general system, and it is high time that there was international agreement on the subject.

Among the many interesting papers communicated must be mentioned two papers by Sir Henry Lyons on "The Display of Scientific and Technical Objects", and by Dr. F. A. Bather on "The Dissemination of Information by Exhibition and Display". Sir Henry Lyons showed how it is possible to convey a great deal of information to the visitor on a short visit by the arrangement of specimens and models to indicate the development of the idea being illustrated, and by paying attention to his physical comfort. This latter aspect was also emphasised by Dr. Bather. Dr. Prinzhorn contributed a paper on the present problem of the movement in Germany for the standardising of the forms of books and periodicals and of library methods, with reference to its wider interest and international importance. In another communication, Dr. A. Schlomann explained the organisation of the German information service on technical literature.

In view of the recent decision to recommend the Universal Decimal Classification and the subject of the presidential address, problems of classification formed one of the main themes of the meeting. In this respect a paper on "The Inadequacy of the Alphabetical Subject Index", by Prof. A. F. C. Pollard and Dr. S. C. Bradford, provoked considerable discussion. The authors showed that no existing index deals with the whole literature of any one subject or generally covers even a large percentage of the total references required by a specialist. Some remarkable examples were given, which were chosen quite at random. In consequence of this incompleteness, searchers must consult as many indexes as possible. But, as they are nearly all different, each separate system must be studied, thus wasting time and patience. Of the multifarious systems in use, those of the alphabetical class are particularly bad. The difficulties inherent in the alphabetical system of subject indexing are due to the fact that the notions to be indexed may be described in each language by a variety of different combinations of different words, any one of which may be selected for an index entry, and the alphabetical order of no series of selected combinations has any direct connexion with the relationship to one another of the notions expressed. The adoption of the principle of alphabetical arrangement amounts to the rejection of that of classification. But as related subjects are scattered throughout an alphabetical index, cross-references must be added in order to direct the searcher to other headings under which related information may be found. Consequently, most alphabetical indexes are based on an unseen classification, comprising a series of selected subject headings combined with a system of cross-references. When, however, the magnitude of a comprehensive classification of knowledge is realised, it is inconceivable that an adequate concealed classification, weighted with the overwhelming mass of necessary cross-references, could be used as the basis of an alphabetical index.

Prof. Pollard and Dr. Bradford pointed out that in the alphabetical subject-index:

1. References to related subjects must be scattered throughout the whole repertory.

1.1. There is no method of co-ordinating related references within the subject except by a complicated labyrinth of cross-references, which is difficult or impossible to elaborate with completeness, and is time-wasting for the searcher.

2. There is the danger of dissociating references to essentially the same subject by the use of synonyms.

2.1. This danger can be reduced by employing a concealed classification together with a second elaborate system of cross-references, that is, from synonyms. But as the unseen classification is inflexible and necessarily incomplete, the indexer is forced to employ terms, usually taken from the authors' titles, which do not belong to the considered classification and are unconnected with either series of cross-references.

3. Essentially unrelated references are likely to be brought together under terms that may have widely different meanings; such a term as 'Survey' may mean almost anything.

4. There is risk of assuming that an expression used metaphorically is intended literally; and

5. The use of an alphabetical system excludes the possibility of collaboration with other bibliographers, especially in different countries.

5.1. This implies the perpetuation of the present chaos of independent bibliographical effort, with a maximum of inefficiency and of labour to the searcher.

On the other hand, none of these objections is inherent in a classified index, since:

1. Related references are brought together by the classification,

1.1. and consequently cross-references within the subject are not required.

2. The classification enforces the contemplation of notions; the same subject must be indexed in the same place.

2.1. No series of cross-references from synonyms is required, since the classification is not concerned with titles,

3. apparent similarity of terms, or

4. metaphorical expressions. Thus the use of a standard classification ensures a maximum of efficiency, and

5. serves to unify the work of all those using the same system, so that their references may be brought together into a single index, which may be consulted with a minimum effort.

S. C. B.

## Colloid Science applied to Biology.

THE Faraday Society met at Cambridge on Sept. 29–Oct. 1 for a general discussion on colloid science applied to biology. The occasion was arranged by the Colloid Committee of the Society with the intention of bringing together physical chemists and biologists whose interests meet on this field. The attendance was unexpectedly large, and among those present were some twenty delegates from other countries. Before the discussion began, Prof. Wo. Ostwald delivered greetings to the Society from the Colloid Gesellschaft, and Prof. H. F. Burton presented those of the Ottawa Colloid Symposium. The discussions, which extended over three days, were of sustained and exceptional interest.

The subject first discussed was introduced by Prof. A. V. Hill, whose report dealt with a proof, based upon the work of Dr. I. Straub and confirmed by experiments of his own, that although a 'living' membrane, such as that which separates the yolk from the white of an egg, may be fully permeable to water and electrolytes, thermodynamic equilibrium may never be reached across it. The membrane alters the equilibrium by the continuous performance of work. A 'steady state' is maintained, but there is no equilibrium so long as the membrane is 'alive'. Dr. Straub described experiments involving an endeavour to reproduce this condition in the case of artificial membranes. The subsequent discussions showed the biological importance of the facts involved.

In the absence of Prof. Gortner, of the University of Minnesota, his paper on the state of water in colloidal and living systems was taken as read. A discussion of great interest made clear that a definition of 'bound' as contrasted with 'free' water is not yet possible. Different methods give results so diverse that little meaning can at present be attached to the terms in question. Prof. Svedberg then summarised the results of his determinations of protein molecular weight by means of the ultra-centrifuge. Twelve proteins had molecular weights of 1, 2, 3, or $6 \times 34{,}500$, while two hæmocyanins had molecular weights exceeding a million. These are constant over a *p*H range varying from 2 to 8 units, but may dissociate reversibly outside that range. In the discussion which followed, Prof. H. R. Kruyt and Dr. P. Lecomte du Nouy attacked the view that the aggregates the weight of which was thus determined were molecules rather than micelles consisting of numerous molecules. A very wide divergence of opinion on this point was revealed in the debate which followed.

Prof. W. Pauli, of Vienna, described very briefly his recent researches dealing with the behaviour of proteins towards other colloids and towards electrolytes; and Prof. F. F. Nord dealt with the physical influence of gases on colloids. The report of Prof. Fauré-Fremiet dealt with the physiological and physico-chemical factors involved in the active movements of amœbæ, and his remarks were followed by an instructive discussion. A report of Prof. R. A. Peters, of Oxford, giving arguments for the necessity of assuming a permanent architectural structure in protoplasm, led to many interesting expressions of opinion. The familiar difficulty of reconciling such structure with proved fluidity was well to the front. Dr. Cramer directed attention to the significance of structures such as mitochondria and Golgi apparatus; and Prof. J. B. S. Haldane, dealing well with the genes of the geneticist, argued that their history and influence suggest for them a relatively simple chemical constitution with superimposed structure—a combination, as it were, of chemical and morphological patterns.

In the report of Dr. Hans Pfeiffer, of Brennen, the question of the isoelectric point of living cells was raised; and in that of Drs. von Muralt and Edsall —very clearly presented by the former—the technique and results of a study of double refraction in muscle proteins was described. This provoked interesting comments from the physical chemists. Finally, Dr. J. H. Quastel, speaking on mechanisms of bacterial activity, referred to his own theory of molecular activation at the cell surface, and described recent experiments in which it has been found that, after complete lysis, certain dehydrogenases present in the intact cell disappear. Other enzymes, the indophenol oxidase, for example, remain intact.

The complexity of the biological field was brought prominently before the company when, during the first evening, a number of cinematograph films were shown in a theatre at the Engineering Laboratories. These included studies of living cells by Dr. Canti, and one of amœboid motion by Prof. Fauré-Fremiet. A striking film exhibited by Dr. Robert Chambers illustrated the methods of micro-dissection and micro-injection. In relation with these exhibits was a report of Dr. Honor B. Fell, of the Strangeways Research Laboratories, Cambridge, and Dr. Wilmer, on the phenomena observed during the culture of vertebrate cells *in vitro*. Part of this report was presented by Dr. Wilmer during the discussions of the following day.

On the evening of Oct. 1 the members of the conference dined together in the Hall of Pembroke College. The services of Prof. T. M. Lowry, the retiring president, were gratefully acknowledged, and his successor, Dr. Robert Mond, was warmly welcomed.

## Imperial Wool Research Conference.

UNDER the auspices of the Empire Marketing Board, delegates from the Dominions, the chief wool-producing Colonies, and research institutions in Great Britain, together with representatives of Government Departments concerned, met in conference upon matters relating to wool research during the week Sept. 22-26. The meetings commenced with an address by the Right Hon. J. H. Thomas, Secretary of State for the Dominions, who welcomed the delegates and expressed the hope that from the deliberations of the conference the progress of research into the production and utilisation of wool throughout the Empire might be stimulated.

Mr. A. L. Hetherington, of the Department of Scientific and Industrial Research, gave a brief outline of the industrial research associations in Great Britain, mentioning especially the position occupied by the British Research Association for the Woollen and Worsted Industries at Torridon, Leeds. Dr. S. G. Barker followed with a paper on scientific correlation between producer and manufacturer, in which he discussed the difficulties of the manufacturer in dealing with wool in the production of which he was not interested or associated, and of the producer who lost interest in his product so soon as he had completed the sale of it and had had it removed from his premises. He stressed the important point that of all animal products wool alone has to pass through

a definite series of manufacturing processes before the finished article made from it is absorbed into commerce, and the further important point that while the producer's unit is to all intents and purposes the fleece, with the broker's ' sorting ' and the manufacturer's further ' sorting ' the fleece loses its identity long before it reaches a stage where any particularly desirable or undesirable quality can be recognised. This means that it is exceedingly difficult, other than in a very general way, for the manufacturer to express his views in terms that can readily be understood by the producer. Guidance in breeding, feeding, or sheep husbandry for the improvement of the wool produced cannot emanate from the trade organisations representing the manufacturers without some liaison, which could best be provided by a series of scientific research institutions correlated together and cognisant of conditions both of wool production and utilisation. The threat of a revolution in the wool industry based upon the discovery of a method of elaborating a form of artificial wool fibre, which may replace the natural material to a degree equivalent to or greater than that which has occurred in the silk industry, demands that there be a greater correlation between the producer and the manufacturer for the security of each. Such a correlation, in Dr. Barker's opinion, can only come from a thorough understanding of the chemical, physical, biological, and other factors concerning wool itself.

There followed accounts of the results of recent research work and of work in progress in Australia, South Africa, New Zealand, and Canada. The impression gained was that the production of finest quality manufacturing wools is still essentially a monopoly of Australia and South Africa, but that further development is limited, first, by climate and environmental difficulties, and secondly, by the economic menace of the chief competitor of wool, namely, mutton. It would seem that as the large sheep-walks are broken up and more intensively grazed, so does the stock-carrying capacity of the land increase, until there comes a time when in the natural evolution of arable from grazing land the owner is compelled to turn his attention to mutton production, at the expense of his wool quality, the ideal dual-purpose sheep not yet existing.

In the extension of the sheep-walks on to unsettled land, two important limiting factors must be overcome—the deficiency of phosphorus and the inadequacy of a natural supply of protein. It would appear that South Africa's more pressing problem is the provision of a phosphorus compound in a cheap, readily assimilable form, and to this Australia adds that particular sulphur-containing protein which shall eventually prove to be most suitable for the needs of the sheep—but both would welcome a more regular and even rainfall.

Dr. J. E. Nichols reported briefly and in general upon his recent survey of the wool-producing parts of the Empire. He spoke from the production end of the wool industry and indicated the factors arrayed against the production of a uniformity of fibre which would be regarded by the manufacturer as ideal. He stressed the individuality of the sheep farmer and the variety of the environmental conditions under which he works, the variation in breed, in breed type, between individuals, and even in fleeces. He indicated the economic result of producing an article like wool, which is entirely absorbed, including off types, by-products, and waste, away from the farm by the manufacturer.

The most pressing problems in the production of wool are not those of nutrition or disease of the sheep, important though these may be for any one generation, but are problems of genetics and breeding. Only by breeding on sound lines will real successive improvements or the maintenance of excellence in a stock community be achieved.

The delegates then visited Leeds, where, between the regular sessions for discussion, they had an opportunity to see the work in progress, chiefly on the manufacturing side of wool research, both at Torridon and at the Textile Department of the University of Leeds. They also visited, during the week, the Bradford Technical College and the Bradford Conditioning House.

The last session of the conference was held in Edinburgh, at the Animal Genetics Department of the University, where papers relating solely to the biology of the fleece and the physiology of wool production were discussed. The delegates were shown the methods adopted to throw light upon the purely fundamental problems of wool production from physiological and genetical aspects.

At the final meeting, certain resolutions were passed, and these will be reviewed by the Research Sub-Committee of the Imperial Economic Conference now in session.

## University and Educational Intelligence.

Birmingham.—The following appointments to the lecturing staff have been made: Dr. G. E. Harrison (physics), Dr. C. R. Porter (chemistry), Mr. H. M. Bateman (civil engineering), Mr. W. E. Isaac (botany), and Mr. N. M. MacElwee (mining electrical engineering).

Mr. D. J. Cameron has been appointed Registrar in succession to the late Mr. J. H. Costain.

The Wardenship of Chancellor's Hall (vacant by the retirement of Prof. F. Tillyard) has been filled by the appointment of Major Robert C. Panton.

London.—In recent years science courses have not been in very great demand in University Extension work in London, but the current programme issued by the University shows that lectures on scientific subjects are coming again into popular favour. Foremost amongst the courses arranged is a series of twenty-four lectures by Prof. D. M. S. Watson on modern ideas and work in zoology, which are being delivered on Monday evenings at Gresham College, Basinghall Street. The time of the lectures—six o'clock—should prove ideal for those city workers who are interested in this subject and desire to hear of the most recent advances and the outlook for the future. Courses in evolution, heredity, and biology are being given by Mr. G. C. Robson in such widely separated parts of London as New Cross, Stratford, and Woolwich; and Mr. Barratt Brown is conducting an introductory course in psychology at the Mary Ward Settlement on Friday evenings. Details regarding these and other courses may be obtained from the University.

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The Trustees of the Busk Studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1930–31 to Mr. R. H. Francis, of the University College of North Wales, Bangor.

A special course of lectures on " Some Newer Therapeutic Agents: their Pharmacological Identification and Tests, with some Account of their Uses in Medicine " will be given by Dr. J. H. Burn, director of the Pharmacological Laboratories, Pharmaceutical Society of Great Britain, in the Society's Lecture Theatre, 17 Bloomsbury Square, on Monday, Oct. 13, and succeeding Mondays, at 5.30 p.m. Admission to the first lecture is without ticket.

## Historic Natural Events.

**Oct. 13, 1913. Low Temperature in the Upper Air.**—It has been known for many years that at high levels over temperate and equatorial regions the temperatures of the air are far lower than any ever recorded on the earth's surface. The lowest known temperature above the British Isles is −98° F. which was recorded by a balloon carrying a small meteorograph, at a height calculated as 7·8 miles (12·5 km.) above Pyrton Hill, on Oct. 13, 1913. Still lower temperatures have been recorded over equatorial regions, the minimum being −133° F. at a height of 10·6 miles (17 km.) above Batavia, Java.

**Oct. 13–14, 1881. Great Storm over British Isles.**—This was one of the most severe gales of the second half of the nineteenth century in the British Isles. A very deep depression travelled in an east-north-east direction across the extreme north of Ireland and the south of Scotland. The storm caused great loss of life at sea, 108 vessels being posted at Lloyd's in one day, and there was also much damage on the land, especially in the south of Scotland and the north of England. In London the gale caused eight deaths.

**Oct. 14, 1755. Red Fog and Red Snow in Locarno.**—In Locarno a very hot wind blew with a red fog, followed by blood rain; in the Alps red snow fell accompanied by violent thunder. This was evidently a strong *Föhn* carrying dust from the Sahara.

**Oct. 15, 1811. Comet.**—During the autumn of 1811 the great comet in the night sky was an arresting object with its bright nucleus and curved tail that was 26° in length (equivalent to 100 million miles) and 5° broad on Oct. 15. This comet, of the exceptional duration of visibility of seventeen months, was one of the most memorable of the nineteenth century. It is described by Sir William Herschel in *Phil. Trans.*, p. 115-143; 1812.

**Oct. 15, 1885. Gale at Partenkirchen, Bavaria.**—A barometric depression travelled northwards from the Sahara, and a *Föhn* blew in the Partenkirchen Valley, increasing in force until 7 P.M. From 5 to 8 P.M. the storm was the most destructive known since 1821–22. Houses were unroofed, windows were blown in, and a million large trees were uprooted. The rain which accompanied the storm left a yellowish-red deposit, presumably sand from the Sahara. Temperature rose rapidly from 37° to 70° F., and the melting of the snow, combined with the heavy rainfall, caused serious flooding in the Inn.

**Oct. 16–19, 1848. New Zealand Earthquakes.**—Three great earthquakes were felt, chiefly near the north end of the South Island, on Oct. 16, 17, and 19. Besides the ordinary fissures in the surface soil, a remarkable fracture ran for 60 miles from Cloudy Bay in Cook Strait in a south-south-easterly direction, keeping always parallel to the neighbouring mountain-chain.

**Oct. 16, 1913. Heavy Rain in Malta.**—Very heavy rain fell over the island of Malta, the amount recorded in 24 hours reaching 16·30 in. at Vittoriosa. At Valletta the fall was 12·56 in., of which 6 in. fell between noon and 3 P.M. The rainstorm was accompanied by violent wind and destructive lightning.

**Oct. 17, 1091. Gale in London.**—According to the "Anglo-Saxon Chronicle": "Much harm was done in London with an outrageous wind, the violence whereof overturned and rent in pieces above four hundred houses, at which time and tempest the roof of St. Mary Bowchurch, in Cheap, was also overthrown, wherewith two men were slain. Moreover at Salisbury much hurt was done with the like wind and the thunder for the top of the steeple and many buildings besides were sore shaken and cast down."

**Oct. 18, 1907. Visibility of Mont Blanc.**—An exceptional example of visibility occurred at Dijon on Oct. 18, 1907. As the train left Dijon station, Mont Blanc could be seen very clearly above the chain of the Juras, apparently suspended in the air, only the snow-covered summit emerging. It remained visible until Mâcon was reached. The day was overcast, but the atmosphere was extraordinarily clear, after several weeks of continuous rainfall. The normal limit of visibility of Mont Blanc is 115 miles, and it is extremely rarely seen from the low level of Dijon station 139 miles distant.

## Societies and Academies.

### LONDON.

**Society of Public Analysts, Oct. 1.—G. W. Baker:** Scientific evidence relating to firearms, with special reference to a recent murder trial. Scientific methods of investigation were used in examining the bullet and cartridge case found on the scene of a murder in Jerusalem in August 1929. X-ray photography showed that the piece of a bullet found in one of the bodies was British ammunition, and that it had been fired from a rifle of the same calibre and rifling as that of the accused. Photomicrographs showed that the cartridge case found on the scene had at least fourteen marks on the pin impression, all of which were found on the firing pin of the rifle. The extractor mark was also a very characteristic feature.—**J. W. Croxford:** The composition of rye oil. Two samples of rye, a sample of Ryvita crispbread, and a sample of rye flour, extracted by means of petroleum, yielded about 2 per cent of oil. It was semi-solid, contained 8-10 per cent of unsaponifiable matter, had chemical characteristics similar to those of maize oil, and behaved like a semi-drying oil. It has little, if any, vitaminic activity.—**G. E. Lester Smith:** The determination of unsaponified oil in soap or fatty acids. Modifications of the 'emulsion test', in which the presence of oil in fatty acid is indicated by the turbidity of a solution of the ammonium soap in dilute alcohol, are described. So little as 0·05 per cent of oil can be detected. The test may be made quantitative by a determination of the volume of water required to produce incipient turbidity in an alcoholic solution of the ammonium soap under standard conditions.

### CAPE TOWN.

**Royal Society of South Africa, July 16.—Sir Thomas Muir:** Note on Brioschi's bordered Hessian.—**S. H. Haughton:** Mammoth and elephant teeth from the Vaal River gravels. Nearly every elephant tooth discovered in these gravels has been made the type of a separate species; molars of individuals of the existing African elephant from a single locality show a large amount of variation, and this should be considered in the discussion of the status of fossil forms.—**P. R. v. d. R. Copeman:** Changes in the composition of oranges during ripening. During the period of ripening, the total weight of the orange increases. During the final stages of growth, the effects of transpiration become dominant, causing a loss in weight due to loss of water, which is accompanied by an increase in the concentration of the soluble solids in the juice. There was no significant increase in the nitrogen content or ash content of the juice. The changes in the soluble solids and sugars can be expressed by means of an equation representing an autocatalytic reaction. The changes in the cell-wall material and in the acidity can be expressed by means of a logarithmic curve. Arsenate spray exerts an internal physiological action as a result of which there is a selective oxidation of the respiratory materials in the fruit.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 7, July 15).—Linus Pauling: The structure of some sodium and calcium aluminosilicates. The electrostatic valence rule suggests that aluminium ions in such salts have the co-ordination number 4, the oxygen ions being common to a silicon tetrahedron, an aluminium tetrahedron, and one or more alkali-ion polyhedra. Sodalite, natrolite, the scapolites, and davynite-cancrite have such a structure. It provides, in the zeolite natrolite, channels along (001) planes such that water can escape without rupturing the framework, and sodium ions pass out as other cations enter to replace them (base-exchange).—Arnold Rice Rich: The demonstration that allergic inflammation is not necessary for the operation of acquired immunity. After recovery from infection, the body is often highly resistant to the same infectious agent but is extremely sensitive to products of disintegration of the bacteria, which readily produce local damage and severe inflammation (hypersensitive or allergic inflammation). Contrary to general opinion, active immunity in syphilis and passive immunity to the pneumococcus are not dependent on allergic inflammation; the spread of pneumococcus is inhibited primarily by a specific agglutinative process which precedes inflammation. It is suggested that allergy should be abolished by desensitisation in diseases such as tuberculosis, in which it causes untoward symptoms.—Willem J. Luyten: On the systematic and accidental errors of modern trigonometric parallaxes.—W. de Sitter: On the distances and radial velocities of extra-galactic nebulæ, and the explanation of the latter by the relativity theory of inertia. A theoretical discussion leading to the view that the dynamical solution of the field equations of the general theory of relativity accounts for the expansion of the universe, which is homogeneously filled with matter and has spherical symmetry throughout its history.—S. S. Cairns: The cellular division and approximation of regular spreads.—Harry Levy: Normal co-ordinates in the geometry of paths.—W. A. Marrison: The crystal clock. Consists essentially of a constant frequency generator controlled by a quartz crystal resonator. The crystal is in the form of a ring with the plane of the ring parallel to the optic and electric axes, and is so shaped that its temperature coefficient is as near to zero as desired at a given temperature. The clock can be used to give continuous indication of time, accurate timing signals, or continuous and accurately controlled motion. So far as is known, it is not affected by gravitational and magnetic fields.—Oliver R. Wulf: The band spectrum of ozone in the visible and photographic infra-red. Ozone-oxygen mixtures from a silent discharge ozoniser were examined in a tube 2·5 cm. in diameter and 33 metres long. The bands observed are diffuse, suggesting predissociation of the ozone molecule, and there appears to be a weakening of the weak bands with respect to the strong bands with reduction of temperature. This suggests a means of determining the temperature of the atmosphere at the ozone layer.—Richard C. Tolman: On the estimation of distances in a curved universe with a non-static line element. Using the line-element determined in earlier papers, a relation is obtained between angular extension and luminosity of nebulæ which should be just within the range of observational verification.—William Rowan: Experiments in bird migration. (2) Reversed migration. Juncos were submitted to artificial illumination after dusk, so as to simulate increasing length of days; the gonads increase in size and at a certain period appear to release a hormone, which causes migration. They are small birds and protected by law, so in an attempt to verify these findings and to determine the direction of migration which ensues, crows were used. The numbers available were limited but the results suggest that the enlargement of gonads which occurs under artificial illumination leads to a northward migratory movement, similar to that shown by the birds in the free state with the approach of summer. Controls (with gonads practically at minimum) tended to remain at Edmonton, Alberta, when liberated in winter, although crows normally have gone south at the end of summer.

## Official Publications Received.

BRITISH.

Records of the Geological Survey of India. Vol. 63, Part 2, July. Pp. 189-280. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Birkbeck College (University of London). The Calendar for the Year 1930-31 (108th Session). Pp. 245+12. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 44: *Paecilomyces hibernicum*—New Species. By V. C. E. Kennelly and M. Grimes. Pp. 513-516+plates 20-21. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Norman Lockyer Observatory. Director's Annual Report, April 1, 1929–March 31, 1930. Pp. 8. (Sidmouth.)

University of London: University College. Faculty of Medical Sciences. University Centre for Preliminary and Intermediate Medical Studies: Courses for Dental Students, Session 1930–1931. Pp. vi+253-288. (London.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 405, September. Pp. 1089-1232+xxxiv. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Memoirs of the Cotton Research Station, Trinidad. Series B, Physiology, No. 3: Studies of the Transport of Nitrogen in the Cotton Plant, Parts 4 and 5. By E. J. Maskell and T. G. Mason. Pp. 233-267+657-688. (London: Empire Cotton Growing Corporation.)

Department of Scientific and Industrial Research. Report of the Committee on Welded Containers. Pp. iv+51+11 plates. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 18, 19: Studies in the Diflavone Group, by Elizabeth Mary Ryan and Dr. Hugh Ryan; On the Constitution of certain Compounds formed by the Action of Alcoholic Hydrochloric Acid on Unsaturated Ketones, by Brian Coffey and Dr. Hugh Ryan. Pp. 425-439. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

FOREIGN.

Sveriges Geologiska Undersökning. Ser. C, No. 356: Om jordarternas kapillaritet; en ny metod för bestämning av kapillärkraften (eller kapillära stighöjden). Av Gunnar Beskow. With an English Summary: On the Capillarity of Soils; a New Method for determining the Capillary Pressure (or the Capillary Rise). Pp. 65. 1.00 kr. Ser. C, No. 357: On the Constitution of Hydrated Portland Cement. By G. Assarsson and N. Sundius. Pp. 9+2 plates. 0.50 kr. Ser. C, No. 358: Några till den fennoskandiska geokronologien och isavsmältningen knutna frågor. Av Henr. Munthe. Pp. 19. 0.50 kr. Ser. C, No. 359: Förteckning över lodade sjöar i Sverige, 2. Av K. E. Sahlström. Pp. 20. 0.50 kr. Ser. C, No. 360: Gillbergaskålens byggnad. Av Nils H. Magnusson. Summary: The Gillberga Syncline. Pp. 84+2 tavlor. 2.00 kr. Ser. C, No. 361: Fosforitbollar från Visingsöserien? Av Herman Hedström. Pp. 8. 0.50 kr. Ser. C, No. 362: Mobergella versus Discinella; Paterella versus Scapha and Archæophiala (Some Questions on Nomenclature). By Herman Hedström. Pp. 8. 0.50 kr. Ser. C, No. 363: Die Mollusken und Brachiopoden der Schwedischen Kreide. 1: Eriksdal. Von Richard Hägg. Pp. 93+5 Tafeln. 2.00 kr. (Stockholm: P. A. Norstedt and Söner.)

Transactions of the Astronomical Observatory of Yale University. Vol. 7: Catalogue of the Positions and Proper Motions of 7727 Stars. Re-observation by Photography of the Astronomische Gesellschaft Zone between Declinations +55° and +60°, reduced to 1875·0 without applying Proper Motions. By Frank Schlesinger and Ida Barney. With an Appendix containing the Positions of 396 Stars in Sparse Regions, and an Appendix containing the Positions of 80 additional Gesellschaft Stars near Declination 55°. Pp. iii+20+168. (New Haven, Conn.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 8, No. 1. Pp. 37+4. (Tokyo: National Research Council of Japan.)

CATALOGUES.

Iconographiae Botanicae. Supplementum: Scripta Botanica Miscellanea. (No. 76.) Pp. 42. (Berlin: W. Junk.)

The Use of Nickel in Automobile Engineering. By J. B. Hoblyn. (Nickel, Series H5.) Pp. 15. The Condenser Tube Corrosion Problem and its Solution. (Nickel, Series R3.) Pp. 8. (London: The Mond Nickel Co., Ltd.)

Biological Applications of Absorption Spectrophotometry. Pp. 11. (London: Adam Hilger, Ltd.)

Astronomical Instruments and Observatory Equipment. (Publication No. 700.) Pp. 64. (London: Cooke, Troughton and Simms, Ltd.)

Catalogue of Important Botanical Works: Herbals, Pre-Linnean Botany, Early and Modern Gardening, Floras, Forestry, Orchids, Serials, Biology of Plants, etc. (No. 14.) Pp. 24. (London: John H. Knowles.)

The "Holway" Diathermy Apparatus. (Publication No. B/30.) Pp. 8. (London: Newton and Wright, Ltd.)

## Diary of Societies.

*FRIDAY*, OCTOBER 10.

ROYAL SANITARY INSTITUTE (in the Guildhall, Nottingham), at 4.30.—Alderman A. R. Atkey: River Pollution.—Dr. L. P. Lockhart: Industrial Medicine in Relation to Public Health.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

IRON AND STEEL INSTITUTE (Joint Meeting with the Local Branch of the South Wales Institute of Engineers) (at the Royal Metal Exchange, Swansea), at 7.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—N. Heaton: Some Possibilities of Inorganic Paint Vehicles.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—G. E. Windeler: Thermal Progress (Presidential Address).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. Dunlop: The Refining of Cane Sugar.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.—T. H. Turner: Materials Used in Modern Engineering.

INSTITUTE OF METALS (Sheffield Local Section) (in Mappin Hall, Applied Science Department, University, Sheffield), at 7.30.—Prof. F. C. Thompson: Some Observations on the Wire Drawing Process (Sorby Lecture).

RAILWAY CLUB (at 57 Fetter Lane), at 7.30.—C. J. Allen: Notes on Time Tables and Train Running.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—E. W. Brewerton: Presidential Address.—Dr. F. W. Edridge-Green: The Detection of Colour Blindness from a Practical Point of View.

*SATURDAY*, OCTOBER 11.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at the Technical College, Burnley).—F. Griffiths: Belgian Moulding Sands in the Iron Foundry.

*MONDAY*, OCTOBER 13.

INSTITUTE OF TRANSPORT (at Institution of Electrical Engineers), at 5.30.—Hon. Sir Arthur Stanley: Inaugural Address.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 7.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—A. Highley: Presidential Address.

MEDICAL SOCIETY OF LONDON.—Dr. R. A. Young: The Stethoscope, Past and Present (Presidential Address).

SOCIETY OF MOTION PICTURE ENGINEERS (London Section) (at Royal Photographic Society).—P. Smith: Kinephotomicrography.

*TUESDAY*, OCTOBER 14.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—H. S. Glyde: Experiments to Determine Velocities of Flame Propagation in a Side Valve Petrol Engine.

INSTITUTE OF MARINE ENGINEERS, at 6.—O. Wans: The Design and Manufacture of Marine Auxiliary Oil Engines.

INSTITUTE OF METALS (North-East Coast Local Section) (in Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne), at 7.30.—C. Gresty: Chairman's Address.

ROYAL SOCIETY OF MEDICINE, at 8.30.—Dr. C. Jackson: Suppurative Diseases of the Lungs (Lecture).

*WEDNESDAY*, OCTOBER 15.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield), at 2.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—E. Harle: A Practical Application of British Standard Limits and Fits to Locomotive Construction.

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.—J. E. Barnard: Demonstration by Micro-Projection of some Histological Preparations from the Society's Collection.—Dr. G. M. Findlay: Some Recent Research on Malarial Parasites.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum, South Kensington), at 5.30.—H. P. Vowles: Enquiry into Origins of the Windmill.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Grand Hotel, Birmingham), at 7.—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

SOCIETY OF RADIOGRAPHERS (in Reid-Knox Hall, Welbeck Street), at 7.—C. L. Winch: Presidential Address.—Dr. E. C. Jerman: Address.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—L. le Conteur: Safety and Welfare in Factories.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—J. W. Cuthbertson: Practical Difficulties in the Electrodeposition of Chromium.

*THURSDAY*, OCTOBER 16.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Joint Meeting of Pictorial and Kinematograph Groups), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. J. B. Firth: Some Methods of treating Trade Effluents.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—R. L. Smith: The Vickers Projection Microscope.—Demonstrations of The Vickers Pyramid Hardness Testing Machine, C. Baker's Works Projection Microscope, and C. Baker's Brinell Microscope.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—P. L. Roberts: The Replacement of Castings by Weldings.

CHEMICAL SOCIETY, at 8.—Ceremony of the Unveiling of the Perkin Memorial Plaque.—Prof. W. N. Haworth: Oration on the Life and Work of the late Prof. W. H. Perkin.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.1), at 8.15.—Dr. F. Marsh: The Etiology of Heat Stroke and Sun Traumatism.

BRITISH INSTITUTE OF RADIOLOGY (in Reid-Knox Hall, Welbeck Street), at 8.30.—Dr. J. F. Bromley: The Use of Negative Paper.—Capt. A. R. Wood: Ultra-Violet Glasses.—G. Simon: The Use and Technique of Diathermy in the Treatment of Pneumonia.

INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—S. Myer: The Season's Hops.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Middlesbrough).

*FRIDAY*, OCTOBER 17.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. St. L. Pendred: Presidential Address.

IRON AND STEEL INSTITUTE (Glasgow Section, jointly with West of Scotland Iron and Steel Institute) (at Royal Technical College, Glasgow), at 7.15.—R. Hamilton: Presidential Address.—Discussion on papers by H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice; and J. Šarek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. H. Flowers: The London Automatic Telephone System.

*SATURDAY*, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Prof. J. B. Leathes: Harveian Oration.

### PUBLIC LECTURES.

*SATURDAY*, OCTOBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Native Life in the Solomon Islands.

*MONDAY*, OCTOBER 13.

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. P. Gilding: The Reticulo-Endothelial System. (Succeeding Lectures on Oct. 20, 27, and Nov. 3.)—At 6.30.—Miss M. S. West: The Comparative Study of the Religions of the World (Introductory Lecture).

*TUESDAY*, OCTOBER 14.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Area, Territory, Climate, Vegetation, Mineral Resources.

BEDFORD COLLEGE, at 12 noon.—Miss Tarrant: History of Greek Philosophy.—At 3.—Prof. Spencer: History of Chemistry.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. C. Spearman: Psychologies of To-day (Introductory Lecture).—J. H. Welweg: Danish Castles and Manor Houses. (Succeeding Lectures on Oct. 22 and 29.)

*WEDNESDAY*, OCTOBER 15.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: The Prevention of Accidents, Disorders and Disease in Members of the Medical and Nursing Professions.

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Regent Street Polytechnic Extension, Little Titchfield Street, W.), at 5.30.—Prof. J. L. Myres: Native Races of the Empire: Facts and Problems.

KING'S COLLEGE, LONDON, at 5.30.—Sir Humphry Rolleston, Bart.: Medicine.

*THURSDAY*, OCTOBER 16.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. C. K. Millard: Contraception and the Medical Officer of Health.

KING'S COLLEGE, LONDON, at 5.—Dr. J. A. Hewitt: Metabolism of the Carbohydrates and Fats. (Succeeding Lectures on Oct. 23, 30, and Nov. 6.)

KING'S COLLEGE, LONDON, at 5.15.—Miss C. Maxwell: Chateaubriand and the French Romantics.

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. E. G. Gardner: The Psychology of Dante.

*SATURDAY*, OCTOBER 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Uses of a Tail.

### CONGRESSES.

OCTOBER 13 TO 16.

CONGRESS OF THE ITALIAN SOCIETY OF SURGERY (at Rome).—Discussions on Treatment of Cranio-cerebral Trauma apart from Gunshot Wounds; Diagnosis and Treatment of Hæmaturia.

OCTOBER 15 TO 23.

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND MEDICAL GEOLOGY (at Lisbon).

OCTOBER 20 TO 23.

FRENCH CONGRESS OF HYGIENE (at Paris).—Discussions on Successive Changes in French Pharmacopœias, Comparative Statistics of Infantile Mortality, Study of the Reports of Health Offices, Hygiene and Reconstruction in the Inundated Districts in the South of France, and Lectures on Psittacosis, by Prof. Sacquéfée, and on Lavoisier as Hygienist, by Dr. Dujarric de la Rivière.