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Intellectual Co-operation.

THE inquiry into the work of the Committee on Intellectual Co-operation of the League of Nations, which has recently been carried out by a small committee under the chairmanship of M. Roland-Marcel, was promoted by the very success of the efforts of the Committee in this particular field of international co-operation. Problems were being submitted to the Committee in increasing numbers, and a real danger had already arisen when the committee was appointed in 1929, that efforts in the field of intellectual co-operation might either overlap unprofitably with the efforts of national organisation or be spread over so wide a field that, with the limited resources at the disposal of the Committee and of the International Institute of Intellectual Co-operation, effective attack on the individual problems would be impossible. No question of restricting the field of co-operation or the efforts of the various organisations already participating was raised. The existence of a very widespread realisation throughout the world of learning of the value and need for co-operation in thought, if the interests not only of peace but also of art and letters and science are to obtain adequate service in a world where politics and industry have already been internationalised, was evident and received further emphasis from the inquiry.

The committee's report covered the methods of work employed in this field, and certain recommendations were made regarding the constitution of the Committee on Intellectual Co-operation itself, together with a proposal to appoint an executive committee consisting of eight members to meet four times a year.

In addition, a programme of work was drafted on broad lines indicating the order of precedence to facilitate concentration upon a selected range of problems. Included in this programme are the development of the exchange of ideas and the promotion of personal contacts between intellectual workers of all countries ; co-operation between institutions engaged on work of an international character ; the general study of certain major problems of international bearing ; international protection of intellectual rights ; and in particular, the propagation by educational methods of the principle of the League of Nations, and a recommendation that the interrupted general inquiry into the position of intellectual life in different countries should be resumed.

Up to the present the conception of intellectual co-operation which has apparently dominated the

work of the Committee of Intellectual Co-operation and of the International Institute is one of co-ordinating the intellectual activities of the world, improving facilities for intellectual life where required, and generally promoting unity between the national groups of learning.

This conception, which was possibly the only one that a temporary committee with limited resources could have adopted, is, however, far from adequate to the problem as it is now revealed. Co-operation in the field of learning must follow the lines of co-operation in the field of industry, and effective collaboration must be established between men of science of different countries in the solution of certain problems. Such a conception would involve the Institute of Intellectual Co-operation becoming a kind of international academy where men of learning would assemble, and inevitably much larger resources than those at present available would be required.

It is, however, such a conception of intellectual co-operation which has inspired the most successful efforts in the field of international science, whether directed by the Committee on Intellectual Co-operation or not. The success of the health work of the League of Nations, as represented by the investigations of the malaria commission, the sleeping sickness commission in Africa, the Singapore Epidemiological Intelligence Bureau, etc., is the fruit of deliberate co-operation in a carefully selected field, the organised attack by scientific workers of different countries upon a common problem. Similar remarks apply to the work of the Committee itself in such fields as those of bibliography, library co-operation, the compilation of an annual list of notable books, and the inquiry into the durability of printed documents.

The revised constitutions recommended for the International Committee and Institute justify some hope that they will be more adequate to discharge the functions required by this conception of intellectual co-operation. There are, however, two points on which it is necessary to insist. The selection of the problems for international co-operation is a critical factor in determining the success of efforts in this field. Not only must the range of subjects be one commensurate to some extent with the resources available, but also it must be one which appeals sufficiently to the majority of the countries represented to ensure the loyal and energetic support of the national groups. Much of the work inevitably must be carried on through the national committees and other channels, and any lack of sympathy of understanding between these and the International Committee would undoubtedly be disastrous.

Equally important, however, is full freedom in selecting the problems for co-operation. Nothing would more surely jeopardise efforts in this field than limitations dictated by political considerations or prejudice. Real co-operation in the field of learning is only possible when the form and extent of that co-operation is determined by the free selection of appropriate problems by the workers themselves, influenced solely by considerations of the available resources and the advantages accruing to mankind.

It must be admitted that while direct political pressure is unlikely, it is difficult to detect or resist indirect pressure. For this reason the active prosecution by the Committee of inquiries concerning the international protection of intellectual rights is highly desirable, and there should be no diminution in the support given to the Advisory Committee on Professional Workers, set up by the International Labour Office in 1928, and on which the Committee on Intellectual Co-operation is represented.

For the full service of science or of any other branch of knowledge in the international sphere, the existence of representative professional organisations in the different countries, having an independent outlook and status, is of fundamental importance. Such organisations are more than a mere safeguard against the political control of efforts in the field of learning. Their contribution and participation are indispensable if the work of intellectual co-operation is to be continuously directed in practical channels and the dissipation of effort in academic or sterile directions is to be avoided.

Co-operation in thought is an essential condition of any form of international progress, and while efforts in the field of intellectual co-operation may well have a powerful indirect influence in promoting other forms of international co-operation, any divorce between learning and action in the field of intellectual co-operation itself would be fatal to such an influence. For this reason a much closer association between the work of the International Committee and that of the national committees and of the national professional organisations is indispensable, if learning is to exert a decisive influence in any field of international relations, and if the scientific study of international affairs is to be no mere academic formula but a vital contribution of science in shaping the destiny of civilisation.

Mr. Winston Churchill on Miseducation.

My Early Life: a Roving Commission. By the Rt. Hon. Winston S. Churchill. Pp. 392+16 plates. (London: Thornton Butterworth, Ltd., 1930.) 21*s.* net.

NOT only out of the mouth of babes but also of public characters may come wisdom—even from a Winston Churchill. The autobiography he has recently published is full of meat for the would-be student of education. Obviously, being the son of his father, with the possibility of genes—this in recognition of the Bishop of Birmingham's reversion to bionomics—from other peculiar forbears, he could not be educable in any ordinary way. He has written a most fascinating account of his irresponsible upbringing, which should shame the devil in all but one of his schoolmasters. The book is to be studied by every teacher who desires to play an honest hand, a warning to every parent.

He went to a most fashionable and expensive preparatory school at seven. He had been so happy, he says, in his nursery with his wonderful toys: a real steam engine, a magic-lantern and a collection of soldiers already nearly a thousand strong. At school it was to be all lessons, seven or eight hours a day except half-holidays, football or cricket in addition. At once he was set down to master the First Declension—Mensa, a table; mensa, O table, etc. He gives a most amusing account of his subsequent interrogation by the form master. He found the vocative a complete puzzle: why two meanings to the same word—why at one time 'a table', then 'O table'? Told that the latter was used in talking *to* a table, he ingenuously and naturally replied, that he never did. "If you are impertinent, you will be punished, . . . let me tell you, very severely", was the conclusive reply. Flogging with the birch, in imitation of Eton, was the great feature in the school curriculum—the floggings "exceeded in severity anything that would be tolerated in any of the Reformatories under the Home Office". Being constitutionally unable to learn Latin, he had his plentiful share of whippings. So he hated school and lived a life of anxiety there during more than two years. The greatest pleasure he had was reading: when nine and a half, his father gave him "Treasure Island", which he devoured with delight. What a book this has been for youngsters—I well remember how it electrified my children, in fact, all of us, when it came out.

"My teachers saw me at once backward and precocious, reading books beyond my years and yet at the bottom of the Form. They were offended. They had large resources of compulsion at their disposal, but I was stubborn. Where my reason, imagination or interest were not engaged, I would not or I could not learn. In all the twelve years I was at school no one ever succeeded in making me write a Latin verse or learn any Greek except the alphabet. I do not at all excuse myself for this foolish neglect of opportunities procured at so much expense by my parents and brought so forcibly to my attention by my Preceptors. Perhaps if I had been introduced to the ancients through their history and customs, instead of through their grammar and syntax, I might have had a better record."

Here the interesting question may well be asked: Whether customs and history can, in any way, take the place of language study? Surely, it is mere pretence to say they can. The study of a language is something apart. Classical custom and history are profitably studied, I venture to think, only in a language with which the student is familiar. Warde Fowler is certainly the best of guides to Rome.

Churchill fell into a low state of health but was only removed from the school after he had a serious illness; he was sent to a small school at Brighton, kept by two ladies, in which he found an element of kindness and sympathy conspicuously lacking in his first school. Query: Should not preparatory schools all be in the hands of ladies? He remained there three years and gradually grew stronger. He was allowed to learn things which interested him—"French, History, lots of Poetry by heart, and above all Riding and Swimming".

He went to Harrow when he was twelve, entering "the inhospitable regions of examinations, through which for the next seven years I was destined to journey". The whole philosophy of examinations is to be read in the following passage in which he sets out this theme:

"These examinations were a great trial to me. The subjects which were dearest to the examiners were almost invariably those I fancied least. I would have liked to have been examined in history, poetry and writing essays. The examiners, on the other hand, were partial to Latin and mathematics. And their will prevailed. Moreover, the questions which they asked on both these subjects were almost invariably those to which I was unable to suggest a satisfactory answer. I should have liked to be asked to say what I knew. They always tried to ask what I did not know. When I would have willingly displayed my knowledge, they sought to expose my ignorance. This sort of treatment had only one result: I did not do well in examinations."

Yet as a man he has done well in after life, as do multitudes who, like him, fail at school. In my long

experience, it is never safe to write down a boy a fool: development so often waits upon age and opportunity. The account which Mr. Churchill gives of his performance at entrance to Harrow is most amusing: he was unable to answer a single question in the Latin paper. Yet the head master, Mr. Weldon, admitted him—doubtless upon his name. He was placed in the bottom form, of which he was last of all during nearly a year. Here comes a golden passage:

"... being so long in the lowest form I gained an immense advantage over the cleverer boys. They all went on to learn Latin and Greek and splendid things like that. But I was taught English. We were considered such dunces that we could learn only English. Mr. Somervell—a most delightful man, to whom my debt is great—was charged with the duty of teaching the stupidest boys the most disregarded thing—namely, to write mere English. He knew how to do it. He taught it as no one else has ever taught it. Not only did we learn English parsing thoroughly, but we also practised continually English analysis. Mr. Somervell had a system of his own. He took a fairly long sentence and broke it up into its components by means of black, red, blue and green inks. Subject, verb, object: Relative Clauses, Conditional Clauses, Conjunctive and Disjunctive Clauses! Each had its colour and its bracket. It was a kind of drill. ... As I remained in the Third Form (β) three times as long as anyone else, I had three times as much of it. I learned it thoroughly. Thus I got into my bones the essential structure of the ordinary British sentence—which is a noble thing. And when in after years my schoolfellows who had won prizes and distinction for writing such beautiful Latin poetry and pithy Greek epigrams had to come down again to common English, to earn their living or make their way, I did not feel myself at any disadvantage. Naturally I am biassed in favour of boys learning English. I would make them all learn English: and then I would let the clever ones learn Latin as an honour, and Greek as a treat. But the only thing I would whip them for is not knowing English. I would whip them hard for that."

I would *force* this passage upon the attention of every English teacher and whip him hard until he mastered its meaning and acted in its spirit. In one of the schools with which I am connected, in which the curriculum had been entirely classical and mathematical, several years ago the decision was taken, partly owing to my insistence, to substitute English for Latin in the Lower School and then to enforce Latin only upon boys of distinct literary ability. The attempt was a failure because the classical masters would not and could not teach English: so they soon reverted to their early evil course of general Latin torture. The experiment has been an interesting one, confirming my suspicion that Latin needs but a lesser level of intelligence in the teacher, also explaining the failure of our schools under classical leadership. As a teacher, in my own subject, I have always insisted upon training in English composition being made part of the course—with little result, I fear, as an example, judging from complaints such as that made recently by Sir William Pope. The time is at hand, however, when we must recognise our own language and those of other moderns.

Winston Churchill spent four and a half years at Harrow, three in the Army class. Officially, he never got out of the Lower School. He had a wonderful memory. While apparently stagnating in the lowest form, he gained a prize open to the whole school for reciting to the head master twelve hundred lines of Macaulay's "Lays of Ancient Rome" without making a single mistake. He passed the preliminary examination for the Army, while still almost at the bottom of the school. Here—let all mark this—his nursery toys came in. He was embarked on a military career. This orientation, he says, was entirely due to his collection of toy soldiers. He had ultimately nearly fifteen hundred. He tells how he arranged his forces, how his father one day made a general inspection and studied the scene with a keen eye and captivating smile. At the end, the father asked him if he would like to go into the Army. Thinking it would be splendid to command an Army, he said 'Yes' at once and was taken at his word. He afterwards learnt that his father had thought he was not clever enough for the Bar. However, the toy soldiers had turned the current of his life.

It took him three tries to pass into Sandhurst. He has much to say about Latin and mathematics and examinations, in this connexion, that should be of great interest to teachers generally. At the close of his career at the Royal Military College, he had been nearly twelve years at school:

"Thirty-six terms each of many weeks (interspersed with all-too-short holidays) during the whole of which I had enjoyed few gleams of success, in which I had hardly ever been asked to learn anything which seemed of the slightest use or interest, or allowed to play any game which was amusing. In retrospect these years form not only the least agreeable, but the only barren and unhappy period of my life. I was happy as a child with my toys in my nursery. I have been happier every year since I became a man. But this interlude of school makes a sombre grey patch upon the chart of my journey. It was an unending spell of worries that did not seem petty, and of toil

uncheered by fruition; a time of discomfort, restriction and purposeless monotony.

". . . I would far rather have been apprenticed as a bricklayer's mate, or run errands as a messenger boy, or helped my father to dress the front windows of a grocer's shop. It would have been real; it would have been natural; it would have taught me more; and I should have done it much better.* *Also I should have got to know my father*,† which would have been a joy to me.

"Certainly the prolonged education indispensable to the progress of Society is not natural to mankind."

Cannot we make school—'natural to mankind'? Surely, we must! Surely we could, if sympathy and scientific thought were brought to bear upon the task!

The desire for learning came upon Churchill when he was nearly twenty-two, a cavalry officer at Bangalore. It is a fascinating and suggestive story. He had picked up a wide vocabulary but caught himself using many words the meaning of which he could not define precisely. (We all do this but how many recognise their deficiency.) He had heard a friend say: "Christ's Gospel was the last word in Ethics". This sounded good but what were ethics. They had never been mentioned to him at Harrow or Sandhurst. There was no one at Bangalore to tell him about ethics for love or money. Other similar needs pressed upon him. Someone spoke of the Socratic method. What was that? Then there was history. He had always liked history but at school was given only the dullest, driest, pemmicanised forms like "The Student's Hume". How true is this and not of history alone! So he set himself to read history, philosophy, economics and things like that. The effect upon him is summarised in the following most noteworthy statement:

"When I am in the Socratic mood and planning *my* Republic, I make drastic changes in the education of the sons of well-to-do citizens. *When they are sixteen or seventeen* † they begin to learn a craft and to do healthy manual labour, with plenty of poetry, songs, dancing, drill and gymnastics in their spare time. They can thus let off their steam on something useful. It is only when they are really thirsty for knowledge, longing to hear about things, that I would let them go to the university. It would be a favour, a coveted privilege, only to be given to those who had either proved their worth in factory or field or whose qualities and zeal were pre-eminent. However, this would upset a lot of things; it would cause commotion and bring me perhaps in the end a hemlock draught."

* It is noteworthy that nowhere does Churchill mention having had manual instruction.
† My italics.

May we not hope that it is not too late for him yet to qualify for that draught? Why not make himself Minister of Education in the next Government: then, following Christ's example, clear out the money-changers from the school temples.

The one strange thing is that nowhere in the book is the slightest reference made to the part played by 'natural science' and 'scientific method' in our affairs, beyond the vague statement:

"I wonder often whether any other generation has seen such astounding revolutions of data and values as those through which we have lived. Scarcely anything material or established which I was brought up to believe was permanent and vital, has lasted. Everything I was sure or taught to be sure was impossible, has happened."

Is the explanation, 'faulty schooling' or 'innate disability'—such as that shown towards learning Latin?

To me the book seems to be the most fascinating and important contribution to the study of educational practice of recent times, showing as it does the great need of an entire departure in method. On all grounds it is to be commended both to teachers and parents of sufficient intelligence to read between the lines and ponder the lessons it conveys; with sufficient courage to defy present soul-killing school conventions.

HENRY E. ARMSTRONG.

Applied Optics.

(1) *Applications of Interferometry*. By W. Ewart Williams. (Methuen's Monographs on Physical Subjects.) Pp. vii + 104. (London: Methuen and Co., Ltd., 1930.) 2*s*. 6*d*. net.

(2) *An Introduction to Applied Optics*. By Prof. L. C. Martin. (The Specialists' Series.) Vol. 1: *General and Physiological*. Pp. ix + 324. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 21*s*. net.

(3) *The Use of the Microscope: a Handbook for Routine and Research Work*. By John Belling. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xi + 315. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s*. net.

(4) *Lecture Experiments in Optics*. By B. K. Johnson. Pp. 112. (London: Edward Arnold and Co., 1930.) 8*s*. 6*d*. net.

THE value of all branches of physics to industry is becoming more and more obvious every year, and manufacturers are finding that many important processes hitherto carried out empirically by their workmen, by methods depending

solely upon previous experience, can be controlled with far greater certainty by the use of physical apparatus. Among these controls there are many based more or less directly upon applications of optics, and the books under review contribute to the study of these applications.

(1) This is more particularly true of the first of the above books, upon the applications of interferometry, in which is given very concise explanations of a set of closely allied phenomena which have many important applications in metrology, in the study of spectra, and in the final surfacing and testing of lenses, lens-systems, and prisms. Interferometry has recently been brought into special prominence due to the famous experiments of Michelson and Morley, which have led to a revolution in our conception of the universe through the theories of relativity, largely suggested by and founded upon these experiments.

After a general introductory chapter, the author deals successively with interference phenomena under the following classification: (*a*) From a point or line source as in the Rayleigh interferometer and diffraction gratings; (*b*) involving a division of amplitude (Newton, Brewster, and Jamin); (*c*) by Michelson's method; (*d*) by simultaneous division of amplitude and wave front (Fizeau, Twyman and Green, Köster); (*e*) involving multiple beams (Fabry and Perot, Lummer).

This classification, while not free from criticism, will be of assistance in enabling the reader to distinguish between the different varieties of phenomena which can be produced—and no one can help being struck by the many types of interference which are possible and by its numerous applications. Each of the six chapters is followed by a valuable list of references to original papers on the subject of the chapter.

(2) We have in Dr. Martin's "Applied Optics" (of which this is announced as the first volume only) a general theoretical and practical treatment of the subject, which is based throughout on the ray or geometrical basis. In defending this mode of treatment, he rightly says that "the wave theory is no nearer 'reality' than the ray. It tells us nothing as to what actually happens in the region of the focus."

In the first two chapters are obtained the formulæ for lenses, single and in combination, and examples are given of trigonometrical ray-tracing. Chap. iii., on the "Physical Study of Light", deals briefly with diffraction, interference and its effects, radiation, and absorption. In the next chapter the aberrations of optical systems are dealt with—the sine condition, Seidel's aberrations, Petzval's condition, with their formulæ; but for the calculation of aberration-free systems the student is referred to Conrady's well-known "Applied Optics and Optical Design". In Chap. v. the author describes the eye and its properties, but he returns to physical optics—polarisation, crystallography, dispersion achromatism, and lens working—in the next two chapters; we should have thought that these chapters should have preceded Chap. v., for in the last chapter he deals with visual optics and the correction of defective eyesight.

All this is treated clearly and carefully and without the aid of higher mathematics; it should prove of very great assistance, not only to the ordinary students and those who desire to proceed to the higher branches of applied optics and optical design, but also to those who wish to understand thoroughly the refractive errors of the eye and their correction.

(3) The third book is essentially a practical one, giving empirical directions for the management of the microscope. It is probably not too much to say that the greater percentage of the users of the microscope do not know how to take full advantage of the wonderful instrument with which the manufacturers have provided them. The modern objective is perhaps one of the greatest products of inventive skill to be found in any field, and, when used as it should be, is a marvellously perfect instrument. Indeed, the workmanship of the lenses and their mounting are usually so good that the objective can generally be relied upon to give images which approximate closely to those theoretically possible; but only by close attention to every detail of manipulation is it possible to obtain such an image, and this, of course, is especially true of the high-power immersion objective.

It is in the management of the illuminating system that most users of the microscope fail. For some twenty or thirty years there was great controversy as to the correct method of illumination for high-power work, but it is now generally agreed that each point of the object should be illuminated by a cone of light focused as sharply as possible upon it. For this, a well-corrected sub-stage condenser must be employed to focus the source of light upon the object, and the aperture of this cone of light should be nearly as large as the aperture of the objective, if the objective is to be used to its full advantage. In Belling's book, the methods of centring and focusing the condenser, the mirror to be used, the type of lamp with its ground-glass screen and diaphragm, the aperture of the incident

cone of light, the use of colour screens, are all fully treated, with directions which no one should find difficulty in following.

In the first six chapters the several types of microscope are described, but there appears to be little guidance to the purchaser of the instrument as to the type which would best suit the work for which he is proposing to use it. Then follow the chapters on illumination, light filters, the condenser, the mounting of objects, the objective and other cognate subjects; in all, there are twenty-seven chapters. The more important chapters are summarised, and there is also added to several of them a list of rules. There is thus a good deal of repetition which some readers will think unnecessary, but it may be helpful in impressing the necessary steps upon the beginner. No attempt is made to give any theoretical discussion of the rules recommended; there appears, for example, to be no reference to the size of the diffraction disc, and no explanation why the limit of resolving power should depend upon the working aperture. Rules are all given empirically.

The book is written by a practical user of experience, and should be valuable to anyone who finds himself confronted with a complicated piece of apparatus, usually with very little reliable help. There is added a glossary, and a list of 157 references to books and papers on the use of the microscope.

(4) The fourth book is intended for the use of a lecturer or lecture-demonstrator in optics, and explains how the fundamental lecture experiments should be set up for class teaching. Projection experiments illustrating the laws of reflection and refraction and the passage of light through prisms and lenses are described in a thoroughly practical manner; in most cases diagrams are given, often also descriptions and photographs of the apparatus to be used. These experiments are followed by the more difficult projections of interference, diffraction, and polarisation phenomena. The ripple experiment and the projection of a flat soap or celluloid film would be much improved by the use of a large convex lens, say 4 in., 6 in., or even 8 in. diameter with a focal length of 20 in. to 30 in., placed over the ripple tank or film; the distances should be so arranged that this lens should either focus a slightly divergent beam from the lantern on the aperture of the projecting lens, or form an image of the arc itself upon the lens without the interposition of the ordinary lantern condenser. The beam should be reflected down through this large lens, on to the film placed horizontally; the light that is reflected back from the film passes a second time through the lens, and just before it reaches its focus it should be reflected forward by a prism into the projecting lens. When the projecting lens is being used for the projection of ripples, an iris diaphragm placed in or near it will help to intensify the image and show up the ripples. R. S. C.

Hydrogen Ion Concentration of Plant Cells.

Hydrogen-ion Concentration in Plant Cells and Tissues. By Prof. James Small. (Protoplasma-Monographien, Vol. 2.) Pp. xii + 421. (Berlin: Gebrüder Borntraeger, 1929.) 30 gold marks.

THE difficulties in the way of determining the hydrogen ion concentration of the interior of plant cells are great and they have retarded any real advance in our knowledge of the operation of hydrogen ion concentration as a factor governing the activities of the cell. Of the three more obvious methods, the most attractive, that of using micro-electrodes, has proved unsuitable even in the case of single cells, as apparently the results are liable to be affected very considerably by the oxidation-reduction potential of the protoplasm. A second method, that of measuring the hydrogen ion concentration of the expressed plant sap, has been much used, in spite of the known objections that it allows loss of carbon dioxide and also represents materials from cells of very different types, as well as from different parts of the same cell. The third method, that of examining the behaviour towards a suitable range of indicators of sections of plant tissue, has been largely used and developed by Prof. Small and his collaborators, and in this volume he summarises the results they have obtained, as well as the information available from other sources.

The data thus brought together are representative of a very wide range of plant types, and they include the reactions of the various tissues in the organs examined, as well as observations on the diurnal and seasonal variations. In regard to the latter, it is shown that the general tendency of plant tissues is to be more acid in winter. On the other hand, the external cells, which are generally more acid than the inner ones, tend to have a lower acidity in winter. Of equal interest is the author's discussion of the hydrogen ion concentrations of different parts of the same cell, and the observation that the cytoplasm and vacuole may have widely differing *p*H values. Thus in the

more acid cells of potato stems, for example, the cytoplasm was *p*H 5·9, the vacuole sap *p*H 4·8–5·2.

Of great value also is the discussion of the buffer systems responsible for the regulation of acidity in plant saps. The plants examined all differ in detail, but the present data show that the phosphates and bicarbonates, together with the salts of organic acids, exert with the free acids a predominant influence in regulating the *p*H of the sap. The systems present vary, of course, with the plant investigated. In sunflower, the rather feeble buffering effects are apparently due to phosphates chiefly. In apple juice, malates and malic acid appear to play a predominant part. The bicarbonate system so characteristic of animal tissues appears to be much less important in plants, which is not perhaps surprising in view of the great metabolic differences between plant and animal. The continuation of this work will be awaited with great interest by plant physiologists, who are, in the meantime, under a great debt to the author for marshalling the available masses of data into an intelligible and convenient form. W. H. P.

Our Bookshelf.

The Law of Aviation. By Dr. G. D. Nokes and Dr. H. P. Bridges. Pp. xix+220. (London: Chapman and Hall, Ltd., 1930.) 12*s.* 6*d.* net.

THIS book is divided into two sections, dealing with conditions of peace and war respectively. Part I., "Peace"—which naturally deals with the laws, both national and international, governing civil aviation—is as satisfactory as any publication can be at present, remembering the state of flux in which aviation must inevitably be for many years yet. For example, the authors mention that the British Order in Council of 1923 "has been amended since that date not less than ten times".

The first part, dealing with British law, is clearly and fully set out, and constitutes an excellent standard text-book on the subject as it stood at the date of issue, but it should be read subject to alterations by the flood of subsequent amendments.

The chapters on international law are less definite. While the book sets out the laws, both ratified and otherwise, it necessarily cannot always give an account of interpretations of these that have not yet arisen. Unhappily, many nations to-day are using these laws obstructively, in a manner directly opposed to the obvious spirit of them.

The chapter dealing with regulations for safety in flight, both for airworthiness of aircraft and navigation rules, are in a happier condition. These regulations are now tending towards unification between the more important nations, and it is possible to discuss them with more confidence.

Part II. covers the regulation of military aeronautics in war and neutrality. It automatically divides itself into two broad divisions. The ordinary recognised rules of combat, modified as necessary to suit aircraft requirements, are obvious, and the authors' interpretation of them is quite definite. The type of warfare peculiar to aircraft—as, for example, bombing of towns, the exact rights of an airman escaping from a wreck by parachute, etc.—can only be covered by expressions of opinion. Even so, such opinions are valuable coming from legal experts, as both writers are. This section is provocative rather than informative, and it is of the utmost value if read from this point of view.

Lehrbuch der chemischen Physik. Zugleich dritte Auflage des "Grundrisses der physikalischen Chemie". Von Prof. Dr. Arnold Eucken. Pp. xvi+1037. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 56 gold marks.

PROF. EUCKEN'S book "Grundriss der physikalischen Chemie" has now developed into a "Lehrbuch der chemischen Physik". The change of title follows naturally from the fact that the physical aspects of chemistry have developed so rapidly in recent years as almost to obliterate the boundary between the two subjects. Thus, on one side, thermodynamical theory has led to the replacement of concentrations by activities; on another side, quantum theory has made the specific heats of solids a matter for complex physical investigation; and, finally, the application of spectroscopy to the problems of atomic and molecular structure has made it necessary to include a treatise on optics in every work devoted to the study of physical chemistry. Whilst, therefore, space must still be found for the familiar concepts of mass action and the phase rule, there is an irresistible tendency for books on physical chemistry to become even more physical in character, until they become in fact books on chemical physics instead of physical chemistry.

Prof. Eucken's book covers more than 1000 pages and is therefore almost at the extreme limit of bulk for a text-book to be read *in extenso*, even by an advanced student in physical chemistry. Any further expansion would almost inevitably relegate it to the class of works of reference, from which particular chapters may be picked out for special study. Indeed, it already has distinct merits from the latter point of view, since the author has been able to give an account of band spectra, and of some other rapidly developing lines of research, which may be of real service to those chemical students who follow the progress of modern physics with difficulty and with much retardation. A translation into English would, however, very greatly enlarge the scope of its usefulness both in Great Britain and in the United States, since it is a serious handicap to be obliged to read in an unfamiliar language a book of such a size and on a subject which cannot be made easy, even in the hands of the most competent teacher.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 309. Abt. 9: *Methoden zur Erforschung der Leistungen des tierischen Organismus.* Teil 2, Hälfte 2, Heft 3: *Methoden der Süsswasserbiologie.* Pp. 1385-1549. (Berlin und Wien: Urban und Schwarzenberg, 1929.) 9 gold marks.

THE present part of this very useful work is concerned with methods of research in fresh-water biology and contains chapters on a variety of subjects by well-known workers. The portion by Dr. W. M. Rylov on the Limnoneusten is perhaps one of the most interesting as it deals with a subject only comparatively recently brought into prominence. The study of the biology of those organisms which have to do with the surface film is rapidly becoming more and more developed, thanks to Dr. E. Naumann, who suggested the term 'neuston' for the life in this particular habitat. Very special methods are here required, for those of the ordinary plankton worker cannot be used.

The most important members of the limnoneuston are bacteria, monads, and *Euglena*, which live in masses and cause a variety of colours on the water surface. Larger forms may also occur, such as small Entomostraca and insect larvæ. This film life is often at its maximum in the early morning hours, lessening in the afternoon and sometimes broken up in the evening. A windless day is best for collecting. Even an oil-immersion lens is included in the list of desiderata for the excursions of the out-of-door research worker.

Other sections deal with the collecting and culture of Bryozoa, culturing of phyto-plankton and zoo-plankton, methods of manuring aquaria, ponds, and lakes, measurement of the penetration of light into the water by photoelectric cells, and methods of studying plant and animal communities. Dr. E. Naumann's chapters on the breeding of phyto-plankton, Cladocera, Ostracoda, Copepoda, and pelagic Rotatoria are specially good and give a large amount of information in a small space.

The Truth about Publishing. By Stanley Unwin. Third edition. Pp. 359. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.

THERE was a time when the craft of publishing was regarded as something as mysterious as the 'black art', and perhaps scarcely less sinister. Even to-day the misunderstandings are scarcely cleared up: and the 'man in the street' is still under the impression that the publisher is out to fleece the poor author while making enormous profits for himself. The only way to remove that impression is for the publisher to display his whole craft—frankly to lay all his cards upon the public's table: and this is what Mr. Stanley Unwin has done. In this book he describes with utter fidelity the reception and reading of manuscripts—with well-merited praise of the publisher's reader; the 'casting off', and estimating of costs; the publisher's dealings with the author in all forms of agreement; the craft of book production; the business of selling and advertising; questions of copyright and 'rights' generally; publicity, reviewers' copies, free copies, and literary agents.

All that Mr. Unwin says is true, and frankly and wisely he says it. The publisher has a difficult and responsible task. Apart from his technical and complicated business, he must have tact to deal with authors, a *flair* for what the public wants, judgment and sound literary taste—or at least the power of making right decisions from the 'reader's' estimates—and, above all, a real desire to publish what is worth publishing. Mr. Unwin's book has already gone a long way towards developing a right understanding of the publisher's aims and work, and must be of the greatest help to the inexperienced author. The present writer, being himself an author-publisher, and thus able to see both sides of the publishing question, is glad of this opportunity of congratulating Mr. Stanley Unwin on writing so true and valuable an exposition.

Alluvium: Grundsätzliches und Programmatisches zur Geologie der jüngsten erdgeschichtlichen Epoche. Von Kurd von Bülow. Pp. viii + 178. (Berlin: Gebrüder Borntraeger, 1930.) 13·50 gold marks.

THE author uses the term 'alluvium' in a stratigraphical sense, to include both the epoch that dates from the beginning of the last retreat of the ice and the various deposits which have been formed—and still are being formed—in different parts of the world during this unfinished epoch. Without going into great detail, a very clear and concise summary of our present knowledge of post-glacial deposits is presented. Geographical distribution, relations to climate, petrological characters, stratigraphical succession, and biological considerations all receive their due recognition. The descriptions of the deposits themselves are based on a cross-classification of climatic zones against facies. The latter include sub-aerial (æolian and soils); sub-aqueous (fluviatile and lacustrine); organic; glacial and fluvio-glacial; marine and littoral; and volcanic. So far as practicable, each of these groups is described in turn for the polar, tropical, desert, and temperate zones.

The method is a valuable one, for not only is it well designed to cover the whole field, but it also brings out the many gaps that still remain to be filled up by further exploration and research. To afford an ideally sound basis for comparative stratigraphy and palæoclimatology, the changing characters of each facies as it is traced over the whole earth should be thoroughly known. This ideal is being actively pursued in the study of soils and peats, but even for these important facies it is still impossible to give a satisfactory world survey.

The book can be cordially recommended. It presents a well-balanced picture of a vast and ever-growing subject, and contains the very useful soil map of the world prepared by W. Hollstein for the "Handbuch der Bodenlehre." Not least of its merits from our point of view is the clarity of the style; the involved sentences beloved of many German authors are here notably rare.

Letters to the Editor.

he 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.*]

Effect of Internal Stress on the Magnetic Susceptibility of Metals.

THE effect of cold-working or internal stress on the density, electric resistance, elastic constants, thermo-electricity, etc., for various metals and alloys has been a favourite subject of investigation, but few experiments have been made to ascertain the effect on the magnetic susceptibility of metals. We have been working at this subject for a considerable time and have found quite recently the extremely important fact that the diamagnetic susceptibility of a metal belonging to the cubic system decreases in a marked degree by cold-working, and that, by a severe cold-working, the susceptibility of copper is changed from diamagnetic to paramagnetic.

The cold-working was given to metals by means of a large press, the total maximum pressure of which

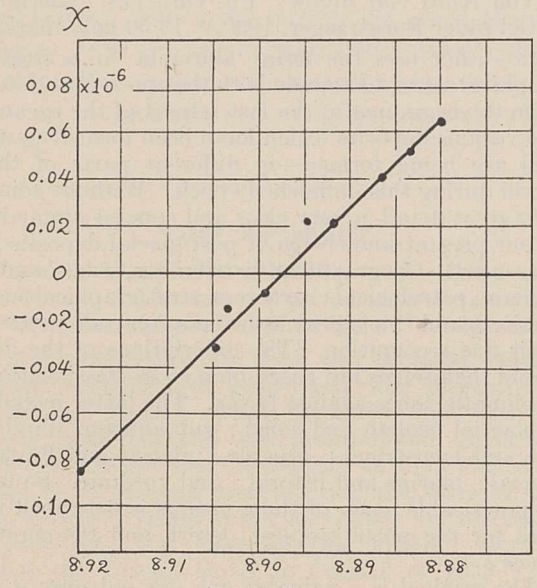

FIG. 1.—Copper.

amounted to 300 tons, or 300,000 kgm. All the necessary precautions for preventing the direct contact of the specimen with iron pieces, by washing it with acid, alcohol, etc., were taken. The measurement of susceptibility was made by means of Weiss's electromagnetic method (Honda's "Magnetic Properties of Matter" (1928), p. 125). Two of the most important cases are reported below.

(1) Copper: $\chi = -0{\cdot}083 \times 10^{-6}$, a weak diamagnetic metal. In general, the density of a metal diminishes with an increase of the degree of cold-working or that of internal stress. Hence we may take the change of density caused by cold-working as a measure of the internal stress. Fig. 1 shows a relation between the susceptibility and the density for different degrees of cold-working.

It is a remarkable fact that during the change of density from 8·921 to 8·887, the magnetic susceptibility of copper changes from diamagnetic to paramagnetic. The fact that this change is a true one was confirmed by an annealing experiment. It is well known that internal stress in copper is completely released by annealing it at 350°; hence the cold-worked copper specimen was vacuum-sealed

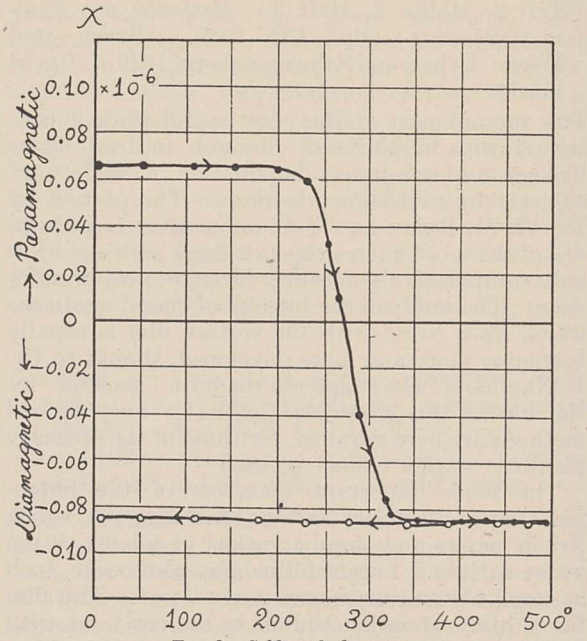

FIG. 2.—Cold-worked copper.

in a small pyrex glass vessel and its susceptibility at different temperatures was measured during a very slow heating and cooling. The result is shown in Fig. 2. The paramagnetic susceptibility of the cold-worked copper rapidly decreases in the range

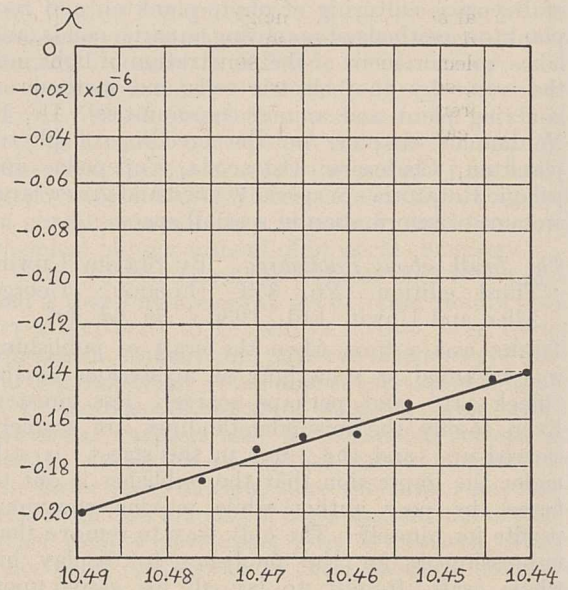

FIG. 3.—Silver.

230°-330°, where the internal stress is released, and takes its original diamagnetic value $-0{\cdot}083 \times 10^{-6}$ at 350°. During cooling, the susceptibility remains almost constant down to room temperature.

(2) Silver: $\chi = -0{\cdot}200 \times 10^{-6}$, a diamagnetic metal. Figs. 3 and 4 show similar curves corresponding to Figs. 1 and 2 respectively. Thus, during the change of density from 10·489 to 10·439, the dia-

magnetic susceptibility changes from $-0{\cdot}200 \times 10^{-6}$ to $-0{\cdot}140 \times 10^{-6}$. From the course of the curve, it might be expected that at an extremely high stress (density = 10·365) the susceptibility of cold-worked

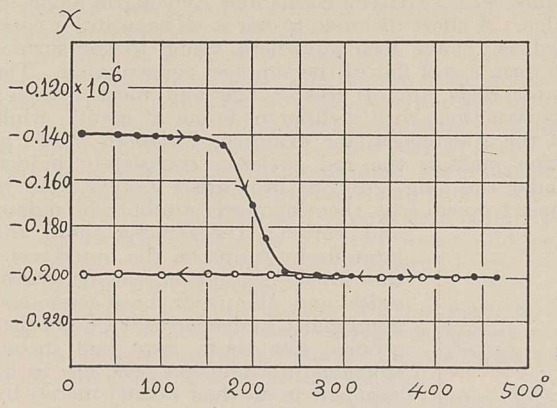

FIG. 4.—Cold-worked silver.

silver will change from the diamagnetic to a paramagnetic. The annealing experiment (Fig. 4) shows also that the change is a true one.

Thus we have now two examples, in which the magnetic susceptibility of a substance changes its sign with external conditions, namely, tin and copper; the former (*l.c.*, p. 134) changes its sign with temperature and the latter with internal stress.

According to Honda's theory of magnetism (*l.c.*, p. 185), the magnetic susceptibility of a substance is the sum of a paramagnetic term χ_p and a diamagnetic one χ_d, that is,

$$\chi = \chi_p - \chi_d.$$

By applying a stress to a metal its density diminishes, and this will cause an increase of χ_p by the decrease of mutual action among neighbouring atoms (*l.c.*, p. 181), and also an increase of χ_d by an increase of bound electrons (*l.c.*, p. 186) at the cost of free electrons, so that in the case of diamagnetic metals the difference $-(\chi_d - \chi_p)$ may numerically decrease as in the case of silver, and may even become positive as in the case of copper, provided that the rate of increase of χ_p is greater than that of χ_d.

KOTARÔ HONDA.
YOSOMATSU SHIMIZU.
Research Institute for Iron, Steel, and Other Metals,
Sendai, Japan, Oct. 27.

Effect of a Direct Current on the Frequency of a Sonometer Wire.

IN a communication in NATURE of May 31, p. 819, Messrs. D. V. Gogate and Y. G. Naik describe an experiment showing that a vibrating sonometer wire undergoes a lowering in frequency when placed in a D.C. circuit. They affirmed that this unexpected result was due neither to the heating of the wire nor to a magnetic action, but at the time offered no explanation of the cause. In their experiment a sonometer wire was tuned to the frequency of an electrically driven fork so that synchronous vibrations of a large amplitude were set up in the wire. When a direct current was sent through it, the amplitude was immediately reduced, and could be restored again to its original width by shortening a little the distance between the bridges, thus showing that the frequency of the wire had been lowered.

This seemingly inexplicable phenomenon aroused some interest in this laboratory, and at the suggestion of Dr. S. J. M. Allen a detailed investigation was carried out. It was found that there is nothing mysterious about the effect. It is simply the result of a decrease of tension in the vibrating portion of the wire due to thermal expansion and the friction at the bridge. This explanation can be verified by the following experiments:

(1) The experiment of Messrs. Gogate and Naik was repeated and similar results were observed.

(2) To test the effect of heating on the wire, a still wire was strung parallel and close to it. When a current was sent through this still wire, a decrease in amplitude of the vibrating wire, similar to that of the previous experiment, was observed. However, when a sheet of mica was interposed between the two so as to cut off immediate heat transfer, the passage of a current through the still wire produced no change in amplitude. The effect of heating was further tested by holding a hot rod close to the vibrating wire. A change in amplitude and accompanying change in frequency, similar to that produced by the current, was at once observed, thus showing that the change in frequency was due to heating.

(3) The fixed end of the wire was attached to a small spring balance which was firmly clamped to the first bridge. Tension was maintained by a weight and pulley. When a current was sent through the vibrating wire, a displacement of the pointer on the balance, as viewed through a low-powered microscope, indicated a decrease in the tension of the vibrating portion. When the current was broken, the pointer moved back to its original position. This proves that the frequency is lowered by a decrease in tension. A curve plotted with change in tension as ordinates and current as abscissæ takes the form of a parabola, but if the square of the current is used as abscissæ the result is a straight line, showing that the change is directly proportional to the heating of the wire.

Wires of different materials were used. It was found that for those having large expansion coefficients the tension change was greater than the corresponding change for wires having small expansion coefficients; for example, the tension change for German silver, having a coefficient of 0·000018, was almost twice as great as that for steel with a coefficient of 0·000010. This shows that the change in tension is dependent upon the expansion of the wire.

As the wire expands and moves over the bridge its motion is opposed by the friction of the bridge so that the slack in the wire is not all taken up by the weight. The tension in the vibrating portion, then, will differ from that on the opposite side of the bridge by an amount equal to the frictional force at the bridge.

(4) To test the effect of the bridge friction, the sonometer was placed in a vertical position and the bridge replaced by a pulley, thus reducing the friction to a minimum. Then, when a current was passed through the vibrating wire, no change in amplitude, and consequently no change in frequency, could be detected, even though large currents were passed through the wire.

Quantitative results will be published elsewhere.

ROLAND SCHAFFERT
(Laws Fellow in Physics).
University of Cincinnati,
Nov. 13.

A Biological Station for the Red Sea.

THE Red Sea is one of the most interesting in the world, and the usefulness of a biological station on its shore scarcely needs emphasis. Owing to its peculiar physical features—desert coasts and a shallow sill separating it from the Indian Ocean—warm water, with active coral growth, and, with

that, the Indo-Pacific fauna, extends much farther north than in any other sea, vigorously growing reefs occurring even at the entrance to the Gulf of Suez in latitude 28° N. Living corals and Alcyonaria of tropical genera are to be found even at Suez, while at a point a few miles south is a bed of at least sixteen species of coral with four of Alcyonaria; coral may, however, grow without any reef formation, and it is doubtful whether a growing reef exists within the Gulf of Suez.

Though much has been done on coral variation, ecology, and physiology, much more remains, and the whole tropical fauna offers problems which have only been touched as yet. A laboratory accessible from the universities of the Old World, and on this classic ground, the origin of so many types, has long been wanted. It will therefore be of interest to all biologists to hear that the new Faculty of Science in the University of Egypt has not been slow to realise the advantage in which it is placed with regard to tropical marine biology, and had carried out two expeditions to the Red Sea before I myself became actively interested.

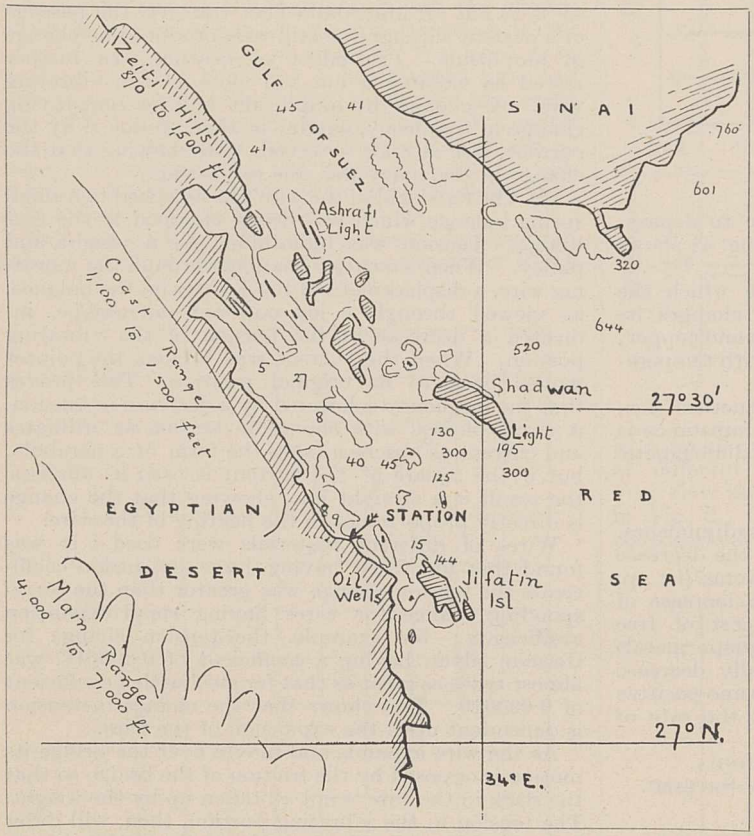

FIG. 1.

The site finally selected is near the Ghardáqa Oil Fields (the name is given as "Hurghada" on the charts, an inversion of the Arabic), within the shelter of the Jifatin and other islands, in lat. 27° 13′ N. A glance at the chart (Red Sea, Strait of Jubal), reproduced as Fig. 1, shows that we are near the southern end of the remarkable maze of reefs and islands, occupying the north-west corner of the Red Sea just south of the entrance to the Gulf of Suez, which is a continuation of the Zeiti coast range and ends in the high island of Shadwan. We thus have every form of reef at our doors, a great area of sheltered water of varying depths, with the 100 fm. line only a few miles to seaward. Our buildings will be on a raised coral reef, the flat surface of which is disintegrated into a gravelly sand; below is a little beach, and reef flats with weeds and marine phanerogams, with scattered corals and Alcyonaria along its edge. A short distance to sea is as beautiful a coral bed as I have seen anywhere, rising to the surface to form a reef flat of the simplest construction. The outer reefs are of greater age and more complex construction, with a different fauna of corals; while of the Alcyonaria, for example, *Tubipora* grows in large masses, the red skeleton completely hidden under the long, grey, or grey-green polyps. As in most tropical seas, the Alcyonaria are both abundant and varied; *Xenia* along shore, the large fleshy forms on the outer reefs, the lovely scarlet or yellow *Spongodes* and the rarer hard-stemmed gorgonians, in deeper water, and other groups, like these, rare and inconspicuous in European seas, are to be seen here in all their beauty merely by looking over the side of a boat.

There is therefore little or no need for a show aquarium at Ghardáqa: Nature provides more than could be shown in any tanks, however well stocked and skilfully kept; and, as the station is for the use of students and research workers only, this expensive department is to be dispensed with. In addition to the vessels used for research inside the laboratories, it is proposed to build two or three shallow ponds on the reef flat, in which the water will be circulated by pumps, and in these close observation of experimental animals will conveniently be carried out, or material can be kept alive until needed indoors. There is plenty of sheltered, yet clean, water in which cages, etc., can be safely anchored.

The station should be useful to other than marine biologists, forming a centre from which the desert fauna and flora, both of the plain and mountains, may be studied more thoroughly than is possible from a temporary camp and when restricted to the cooler months. To the geologist the region is of exceptional interest, not for its oil yield alone, and combined biological and geological exploration of the adjacent islands and reefs may throw light on the coral reef problems. For the inland excursions the necessary motor transport will be provided.

The climate of the Red Sea has an evil reputation, quite undeserved so far as Ghardáqa is concerned, since it is well north of that area of low barometer which separates the prevalent north-west and south-east winds of the ends of the sea, and in which those "cities of dreadful night", Port Sudan, Suakin, and Massawa, have the misfortune to be placed. This is a point of importance to university research workers, who are often free only in the summer months, and it is hoped that, in the selection of the site and design of the buildings, my long experience of the hot central section of the Red Sea will enable me to ensure comfort at all seasons. Data provided by the meteorological office of the Egyptian Government show that at Ghardáqa the average maxima are higher by 1·5° C. than in Cairo during the winter, an advantage to Ghardáqa; in May the same, namely, 32° C.; in June and July slightly lower, and half a degree

higher in August, September, and October. The highest averages are in August, the maximum then being 35·6° C., the minimum 25° C. (77° F.). In point of personal experience, Ghardáqa is far more comfortable than Cairo in August, since every building is open to the breeze, and the wearing of coats, collars, and ties is not enforced.

The station is readily accessible, by land from Cairo, by sea from Suez. The former route involves a night in the train and an eight-hour journey by car across the desert and the Red Sea mountains, following the old road by which the Romans carried porphyry from their quarries in the mountains. From Suez the Anglo-Egyptian Oil Co.'s steamers sail three times a week, reaching Ghardáqa in 16 hours, and supply the oil camp with abundance of fresh water and provisions, so that the hardships of desert life are conspicuous by their absence.

It is hoped that the station will be complete in about a year's time, not only as regards laboratories, apparatus, machinery, and launch, but also with rest houses for research workers and students.

CYRIL CROSSLAND.

University of Egypt,
Cairo.

Change of the Dielectric Constant of Nitrobenzene with Temperature.

I HAVE made a study of the dielectric constant of nitrobenzene as a function of temperature, using a method depending on the beats of two high frequency oscillation circuits, as described by M. Wolfke and W. H. Keesom.[1] Some details concerning the apparatus have been published already in a short note on the dielectric constant of ethyl ether.[2]

It should be stated that the temperature was determined with an error not exceeding 0·005°, and

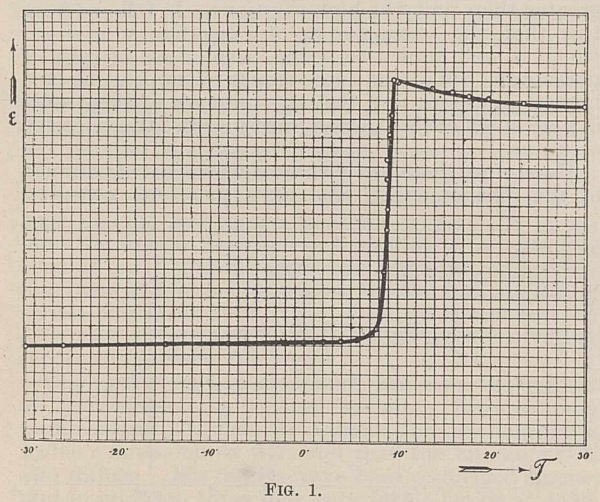

FIG. 1.

the changes in the fifth decimal of the value of the dielectric constant were still discernible.

The changes of the dielectric constant of nitrobenzene with temperature have been studied by Abegg and Seitz.[3] These authors, however, used under-cooled liquid which was not purified sufficiently to obtain results with a very high degree of accuracy, as they themselves point out in their paper.

In my experiments the nitrobenzene was obtained from benzene crystals and was carefully purified by means of the most recent methods. It was afterwards fractionised five times at the interval of 0·05° C.

The dielectric constant was studied through the temperature interval −75°, +30°; special care being taken in the neighbourhood of the liquefaction point. The measurements were made both at increasing and decreasing temperatures.

With decrease of temperature the dielectric constant of nitrobenzene steadily increases from the value 35·4 at 30·01° up to the maximum value 35·18 at 9·6°, in the immediate neighbourhood of the solidifying point. A sharp decrease is then observed down to the value 11·82 at 7·713°, and then a slow asymptotic decrease down to the limiting value 9·709 at −75° C.

These observed changes of dielectric constant of nitrobenzene with temperature do not agree with the results of Abegg and Seitz.

Some irregularities in the rate of change of the dielectric constant in the region of sharp decrease (that is, between 9·6° C. and 7·713° C.) suggest the possibility of some complications in the neighbourhood of the solidifying point of nitrobenzene. A further study will be made to clear up this question.

The change of the dielectric constant of nitrobenzene at temperatures described above is represented on the accompanying graph (Fig. 1).

A full report of the investigations concerning ethyl ether and nitrobenzene will appear in the *Comptes rendus des Sciences de la Soc. Polon. de Physique*, Warsaw, and the *Physikalische Zeitschrift*.

J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Nov. 13.

[1] Comm. Leiden, 190*a*.
[2] NATURE, Oct. 25, 1930, p. 649.
[3] *Ann. d. Phys.*, **60**, 54; 1897.

Persian Science and Jundishapur.

MAY I take the opportunity, afforded by the review in NATURE of Dec. 6 of Sir Percy Sykes's "History of Persia", of directing attention to a point of interest to students of the history of science?

Readers of NATURE will be aware that what we call 'Arabic' science was to a very large extent the work of Persians who wrote in Arabic, though deriving from Greek, Syrian, and Hindu origins. It is also generally known that one of the greatest centres of Persian science was the school or university of Jundishapur. But there appears to be no general agreement as to where this school was situated; and I am hopeful that readers of NATURE may be able to throw some light on the matter. I give below some of the divergent views of authorities I have consulted. It will be noted that the name is spelt in a number of different ways, and, but for encroaching unduly on the space available I would accompany this letter with a plea that a little science should be applied to the transliteration of Oriental names.

Gibbon in his "Decline and Fall of the Roman Empire", chap. xlii., places Gondi Sapor near Susa. Browne in "History of Persian Literature", vol. 1, p. 305, quotes from Carl Brockelmann to the effect that Jundi-Shapur was in Khuzistan, which does not conflict with Gibbon's statement. Sykes in his "History of Persia" (I have not yet seen the latest edition), vol. 1, p. 437, states that Gundisapur is the city of Shapur near Kazerun. This does not agree with the statement that it was in Khuzistan, which also has the support of the "Encyclopædia of Islam" under the heading 'Djundai-Sabur'. The "Encyclopædia Britannica", 10th ed., art. "Arabian Philosophy", refers to "Gandisapora or Nisabur in the east of Persia", thus giving the city a third location. In the 11th edition it is spelt "Junday Shapur" in the article on "Disful", and "Gundev-Shapur" in the article on "Shapur". Both articles place it near Susa. But in

the 14th edition the index says: "Gandisapora, see Nishapur". I find no mention of Gandisapora in any of the articles in this edition referring to Nishapur, so must assume that they are supposed to be the same place. But Nishapur is in Khorasan, whereas the other sites are in Khuzistan and Fars respectively. Berthelot, "Histoire des Sciences", vol. 2, introduction, refers to Gandisapora but does not say where it was. Other references bearing on this matter will be found in Sarton's "Introduction to the History of Science", p. 435, and in "Lands of the Eastern Caliphate", by Le Strange, pp. 262-3; but they do not enable me to decide definitely where this city, so important in the history of science, actually was.

It may be that differences of opinion have arisen through the name of the Persian king Shapur I. (also spelt Sapur, Sapor, Sapores, etc.) being closely associated with Nishapur (Nisabur, Naysabur, Niv-Shapur, etc.) in Khorasan (Khurasan, Korasan, etc.); also with Shapur (Bishapur, Nishapur, Bih-Shapur, Wih-Shapur, Bana Shapur, Shahristan, etc.) in Fars; also with a third city the ruins of which are still to be seen on the road between Shuster and Disful.

Sir Percy Sykes informs me that the city in Fars, near Kazerun, which he believes to have been Jundishapur, was very important with Sasanian bas-reliefs and is still termed 'the city of Shapur'.

HUGH P. VOWLES.

20 Ridgway Place, Wimbledon, S.W.19,
Dec. 8.

Determination of the Velocities of Projectiles by Light Interception.

WE have developed a light interception method for the determination of the velocity of projectiles in the immediate neighbourhood of the muzzle.

The principle of the method is shown in Fig. 1.

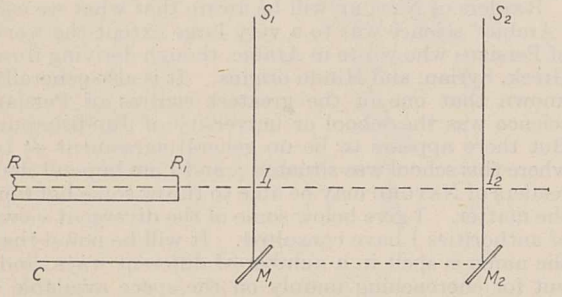

FIG. 1.

RR_1 is the gun. Two beams of light S_1I_1 and S_2I_2 cross the line of flight of the projectile and are brought to a fine focus upon it. The beams are turned by mirrors M_1M_2 and gathered to linear foci, colinear in a vertical sense, on the film of a high-speed camera. The projectile in its flight intercepts first the beam S_1I_1 at I_1 and then the beam S_2I_2 at I_2, causing breaks in the bands of light photographed on the film of the high-speed camera. Time marks are impressed upon the film by means of an Eccles' valve-maintained tuning-fork of 1000~ which carries a small concave mirror on one prong and deflects a beam of light falling upon it. Knowing the distance I_1I_2 and the time between interceptions on the film, the velocity of the projectile may be readily determined. One beam alone may also be used for velocity determinations if the length of the projectile is known.

The method has been used successfully for the determination of the velocity of rifle bullets and shot-gun ejecta. Fig. 2 is a photograph of a rifle bullet velocity determination with two interceptions. In

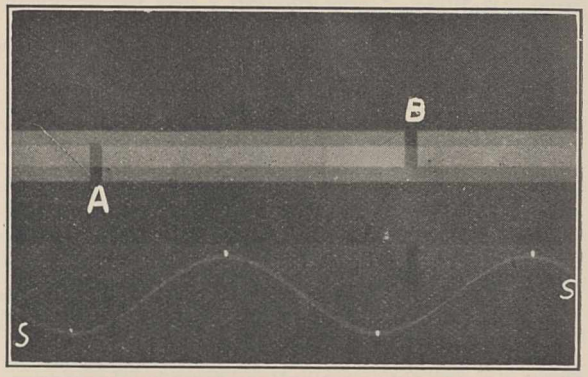

FIG. 2.—*A* and *B* indicate the first and second interception of the line of flight by light rays. *SS* is the time marking.

the discharge from a shot-gun, the interceptions are complex, showing shot column, wad, and cards.

A complete description of the method is being published at an early date.

JAMES TAYLOR.
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Nov. 11.

Viscosity of Electrolytes.

AN important conclusion arrived at in two recent papers on the viscosity of electrolyte solutions [1] is that the relative viscosity of all electrolytes must be greater than unity at high dilutions. It follows from this that the phenomenon of 'negative viscosity', which is well known to occur in solutions of salts of potassium, rubidium, etc., must disappear at the highest dilutions, and that the presence of these salts in very small concentration must increase the viscosity of water.

Heretofore there has been no authenticated instance of this phenomenon. We have therefore measured

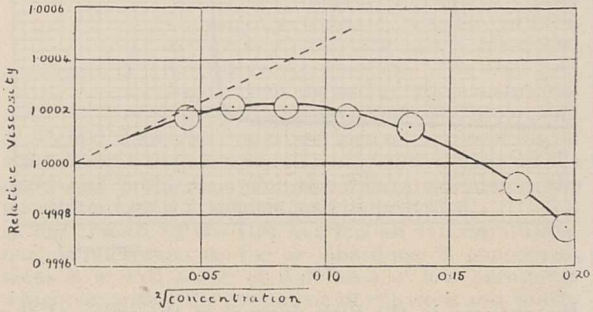

FIG. 1.

the viscosity of dilute aqueous solutions of potassium chloride at 18° C. in silica and glass viscometers of the Washburn-Williams type. Our results for the glass viscometers are represented in the accompanying diagram (Fig. 1), in which relative viscosity is plotted against the square root of the concentration of the solution.

These observations seem unequivocally to show viscosities greater than that of pure water up to a concentration of 0·025 *N*. The dotted line represents the limiting slope predicted by the Dole-Falkenhagen

equation; it will be seen that this line is tangential to the extrapolated curve drawn through the experimental points. A good straight line is obtained by plotting $(\phi - 1)/\sqrt{c}$ against $\sqrt{c}$ (*vide* Jones and Dole) and its intercept on the axis of zero concentration is $-0{\cdot}0052$, in satisfactory agreement with the value of $-0{\cdot}0046$ predicted by the Dole-Falkenhagen equation. The values obtained in the silica viscometers are less concordant but indicate clearly the existence of relative viscosities greater than unity over the same concentration range as that indicated above. It is possible that measurements made with a capillary viscometer at these high dilutions are materially affected by some sort of electro-kinetic effect which will vary with concentration; it is possible, for example, that specific ion adsorption in the capillary may produce an electrical 'drag' on the flowing liquid. It is for this reason that we are carrying out measurements in both silica and glass viscometers.

W. E. JOY.
J. H. WOLFENDEN.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford, Dec. 1.

[1] Jones and Dole, *J. Amer. Chem. Soc.*, **51**, 2950; 1929. Dole and Falkenhagen, *Physikalische Zeitschrift*, **30**, 611; 1929.

Raman Spectra of Some Triatomic Molecules.

IT was observed by me [1] and also independently by Dickinson and West [2] that liquid sulphur dioxide gives three Raman frequencies. The measured wave-number shifts were 526, 1146, and 1340, the line corresponding to 1146 being much more intense and sharper than the two others. The spectrum of sulphur dioxide gas has since been successfully photographed by me and exhibits a frequency 1154, which is distinctly greater than the value 1146 obtained with the liquid and agrees much better with the infra-red value 1152 found for the gas by Bailey, Cassie, and Angus.[3] The two other lines are presumably too weak to be recorded in the case of the gas.

The spectrum of liquid hydrogen cyanide has also been photographed by me and shows a triplet giving the frequency shifts 2076, 2097·2, and 2122, of which the middle component is much more intense than the others; its value 2097·2 is probably accurate to within ± 0·2. Dadieu and Kohlrausch give it as 2092 and do not record its companions.[4] It is interesting to note that Barker,[5] working with hydrogen cyanide gas, found the corresponding infra-red absorption band at 4·7μ to be a triplet, the maxima appearing on his curves at 2088, 2103, 2117 wave-numbers, in each case only a few units different from the values reported above for the liquid.

The case of carbon disulphide has been the subject of investigation by several authors. Krishnamurti found recently [6] that the intense line at 655 has a feeble companion at 647, and that the line at 800 is also diffuse. His results have been confirmed by me, and in addition three new very feeble bands at 4438, 4605, and 4680 A. have been discovered in the spectrum of carbon disulphide excited by the mercury line 4358·3 A. when photographed with long exposures. If these are assumed to be due to Raman transitions, they give us three new characteristic frequencies of carbon disulphide, namely, 412, 1229, and 1577.

S. BHAGAVANTAM.

210 Bowbazar Street, Calcutta,
Nov. 7.

[1] *Ind. Jour. Phys.*, **5**, 35; 1930.
[2] *Phys. Rev.*, **35**, 1126; 1930.
[3] NATURE, **126**, 59; 1930.
[4] *Berichte*, **63**, 1657; 1930.
[5] *Phys. Rev.*, **23**, 200; 1924.
[6] *Ind. Jour. Phys.*, **5**, 105; 1930.

Dangerous Properties of Ethylene Chlorhydrin.

IN the issue of NATURE for Sept. 8, 1928, p. 376, appeared a note on a paper by Mr. F. E. Denny read at the annual meeting of the Society of Chemical Industry in New York, in which he advocates the use of ethylene chlorhydrin for speeding up the sprouting of potatoes, and in which it was indicated that the use of this substance is quite safe from the point of view of the workmen applying it.

During the course of its work in connexion with safety in chemical factories, the Association of British Chemical Manufacturers has recently had brought to its notice (*Zentr. Gewerbehygiene*, 1927, **4** (9), 712) information indicating that this substance possesses unsuspected toxic properties, and that several deaths have occurred in Germany from inhaling the vapour. A somewhat similar case with a fatal termination is reported, for the first time in Great Britain, in the annual report of the Chief Inspector of Factories and Workshops, 1930, p. 95.

The substance apparently acts as a metabolic poison with a specially severe effect on the nervous system, producing muscular weakness, inertness, refusal of food, sleepiness, and finally death by paralysis of respiration.

In view of the increasing use of this substance as a solvent for resins, wax, cellulose, and in the lacquer, paint, and pharmaceutical industries under conditions encouraging evaporation, it seems advisable to direct attention to the above observations, particularly as the substance itself is apparently innocent of all dangerous properties and its action is for that reason all the more subtle.

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Dec. 5.

Determinism.

THE implications of Heisenberg's principle of uncertainty are often seriously confused owing to the ambiguity of the expression 'to determine'. In the present connexion this should mean 'to cause'; what further meaning should be assigned to 'cause' itself is here immaterial. Among other physicists, Prof. G. P. Thomson asserts in "The Atom" (p. 190) that "physics is moving away from the rigid determinism of the older materialism into something vaguely approaching a conception of free will". In any such statement 'determinism' appears to have the sole meaning of 'unvarying causation', apart from which 'free will' is totally irrelevant. Most unfortunately, however, 'to determine' often means merely 'to ascertain', as when we say we cannot 'determine' the exact state of the case. On pp. 193, 194, then, Prof. Thomson substitutes this alternative meaning: "velocity is quite uncertain. A similar result applies if we try to determine the velocity of the electron. . . . There is an exact reciprocity between the exactness with which position and momentum can be determined." Here 'to determine' plainly means not 'to cause', but simply 'to ascertain'. But every argument that, since some change cannot be 'determined' in the sense of 'ascertained', it is therefore not 'determined' in the absolutely different sense of 'caused', is a fallacy of equivocation.

J. E. TURNER.

University of Liverpool,
Nov. 10.

A New Theory of the Evolution of the Insects.

By Dr. R. J. TILLYARD, F.R.S.

A CRITICAL study of the various theories extant concerning the origin and evolution of the insects as a class reveals that there is so far no general agreement amongst biologists on the point at issue. Handlirsch derives them direct from Trilobites. A long line of authors champion the theory of derivation from Crustacea; well-known exponents of this theory are Hansen, G. H. Carpenter, and Crampton. Versluys would derive them, with all other Arthropoda, from the Onychophora, by way of the Myriopoda, considering both Trilobites and Crustacea as side-branches which took to the sea. The famous Campodea Theory of Brauer is only one of a number of more or less diverging views which would derive the insects more or less directly from some type of Myriopoda.

It is interesting to notice which type is considered the most primitive of all insects, according to these various theories. For Handlirsch, the original insect was a winged Palæodictyopteron which arose somewhere in the Carboniferous; the Thysanura and other supposedly primitive apterous forms are, for him, debased side-branches of an originally winged main stem. For those who would derive insects from Crustacea, the family Machilidæ of the Thysanura is the most primitive type. Those who support the myriopod theory find the closest connexion between the Symphyla on one side and the Campodeidæ on the other.

All the theories so far put forward appear to fail at some critical point. Few entomologists can believe that winged insects preceded the oldest wingless forms; it is on this point that Handlirsch's theory, so clearly and fascinatingly presented by its talented author, fails to make appeal. The argument on segmentation drives the adherents of an origin from Crustacea to support a fairly highly evolved type of crustacean, somewhere near the lower Malacostraca, as the ancestor of Machilidæ; but such a theory breaks down when put to the test of detailed analysis. The old crux of the position of the genital pore still stands unsurmounted by those who would like to derive the Campodeidæ from the Symphyla. There is, in fact, no generally acceptable theory as yet.

Where nobody has succeeded, it would seem indeed rash for anyone to make a further attempt. I have, however, done so, not so much with the hope of convincing everybody that I have found the solution, as with the desire to stimulate new lines of thought on a very old problem.*

The theory is built up from the results of an analysis of the evolution of (*a*) segmentation, (*b*) the walking leg, and (*c*) the reproductive system, in insects and other arthropods. As the results obtained from all three analyses were found to agree quite closely, the general theory so constructed was then applied to the evolution of other organs, including the various internal systems, and also to the embryology, with the result that it appears to stand the tests quite well. It also does no violence to the geological record.

In segmentation, attention may be directed to the existence of a nauplius larva in the more primitive types of Crustacea, and to the 'telescoping' of this larval type into the embryology, in certain specialised types such as crayfishes and syncarids. The conclusion is drawn that the Crustacea are derived from a *nauplioid ancestor*, though not from any actual type of nauplius. This would imply *an original lesser amount of segmentation* both in the head and in the body of the animal. As regards the head, the suggestion arises, by comparison of the nauplius head with that of *Peripatus*, that it was originally only four-segmented, and that the mouth was originally closed behind by a flap or process which was not formed from segmental appendages, but was merely a process of the mandibular segment. From this arose the paragnaths in Crustacea and the hypopharynx and maxillulæ or superlinguæ of insects. The addition of either one or two maxillary segments to the head gave rise to all the five- or six-segmented heads now found in Myriopoda, Insecta, Crustacea, etc.

Turning next to segmentation in the Myriopoda, we meet the phenomenon of *anamorphosis*, or the addition of segments during ontogeny by interpolation in front of the anal or preanal segment. Such addition may take place either singly or in groups. The young larva hatches out with relatively few body segments, and at each instar there is an increase by anamorphosis, until the full number is reached. An analysis of the ontogeny of the primitive myriopod group Pauropoda shows that the young hatch out with only six postcephalic segments, of which only the second, third, and fourth carry legs. This is the 'six-legged larva'. It is followed by a ten-legged larval stage, a twelve-legged stage, and a sixteen-legged stage, while the adult pauropod has twelve postcephalic segments and nine pairs of legs. Emphasis is laid on the fact that the total segmentation of the pauropod, inclusive of its five head segments, is less than the total of twenty-one or twenty-two required to derive a machilid direct from a lower malacostracan or a leptostracan.

While all Progoneata appear to be anamorphic, and also many Opisthogoneata, there are also certain higher chilopods which, like the crayfishes, have telescoped all their larval segmentation stages into the egg, and hatch out with the full number of segments belonging to the adult. This phenomenon is termed *epimorphosis*. It is clear that epimorphic forms are, in this respect, more advanced than anamorphic ones.

* The complete new theory may be read under the title "The Evolution of the Class Insecta" (*Papers and Proceedings of the Royal Society of Tasmania*, 1930), which is an amplification of a presidential address on the same subject given in Brisbane in May last, before Section D of the Australasian Association for the Advancement of Science.

When we turn to the insects, we find that almost all of them are epimorphic, namely, the whole of the Thysanura and Pterygota. One small group, the Protura, still exists which exhibits anamorphosis; the larval form has nine abdominal segments, and three more are added just in front of the last, in the form of ring-segments, before the adult stage is reached.

This analysis now brings us to a hitherto neglected group, the Collembola or springtails. These differ from all other insects in having only six abdominal segments right through their embryology, their larval stages, and the adult. A close comparison can be made between this condition, which is really that of possessing *nine* postcephalic segments, and the twelve-legged larvæ of Pauropoda and Symphyla. It is suggested that this condition is even more primitive than that of the anamorphic groups, and should be distinguished as *protomorphic*.

We thus have three stages of evolution in segmentation of terrestrial arthropods: (1) *Protomorphism*, in which an original small number of segments is retained throughout the ontogeny; (2) *anamorphism*, in which this original number is raised, bit by bit, by addition of new segments near the hinder end at ecdysis; and (3) *epimorphism*, in which all this larval addition is telescoped into the embryonic period, so that the young larva hatches out with the full number of segments. The Collembola are claimed to be a remnant of the original protomorphic ancestors or Protaptera; but for the fact that their abdominal appendages have been specialised to serve another function, that of jumping, instead of remaining as walking-legs, they could be classed as very primitive opisthogoneate myriopods. The Protura are a remnant of the later developed anamorphic groups of hexapods. The Thysanura must have begun as Entotrophica and later become more vigorous and developed exserted mouth-parts. The Pterygota or winged insects must have sprung direct from a dorso-ventrally flattened lepismatoid type.

The analysis of the walking-leg brings out two points. First, that there is no evidence of an undoubted exopodite in the legs or maxillæ of terrestrial arthropods, and therefore no need to derive insects from marine forms. Secondly, that the most primitive walking-legs are those of the Symphyla and Collembola, both of which are only actually four-segmented, ending in a claw and empodium. The abdominal styles and exsertile vesicles of the Thysanura are homologous with those of the Symphyla, both belonging to the subcoxal region. The legs of Collembola are even more primitive than those of Symphyla in not possessing either of these organs and also in the non-development of any definite scheme of chitinisation of the subcoxal region.

The evolution of the leg in Myriopoda may be followed out through stages with six, seven, and eight segments, that of insects through stages with five, seven, eight, and nine segments, the latter being the types having a tarsus with five divisions. The additional subdivisions do not take place similarly in myriopods and insects, and hence it is not allowable to homologise the separate segments above the original four in the two types.

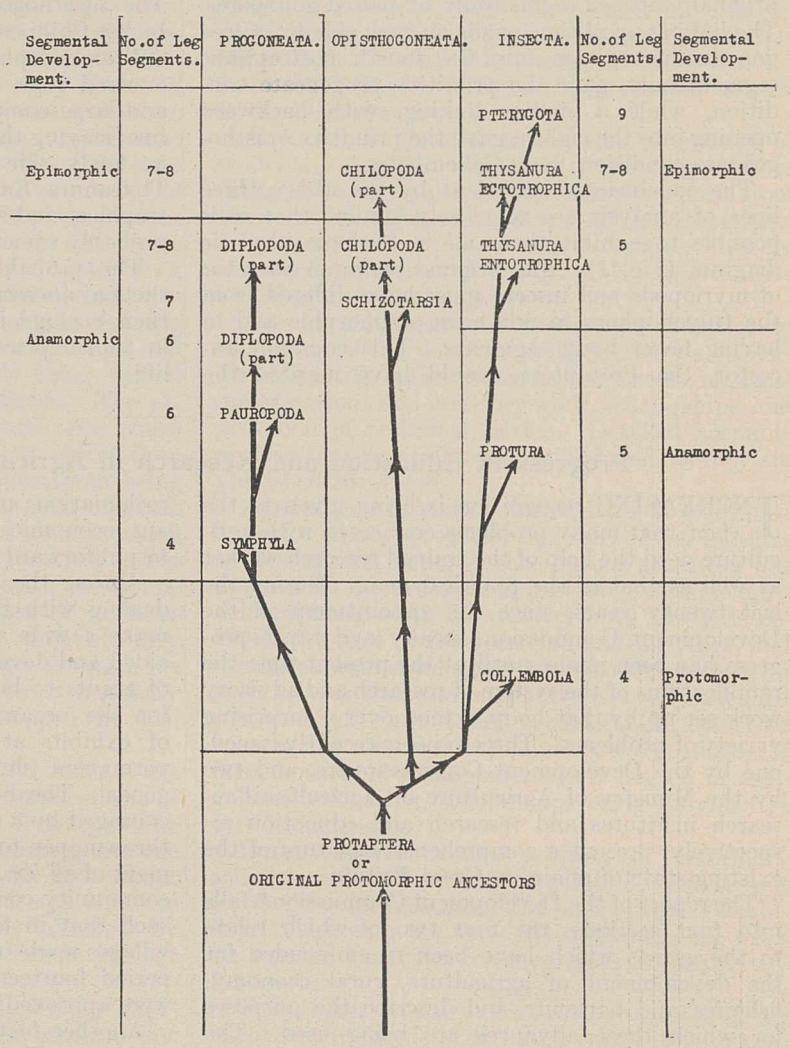

FIG. 1.

Coming next to the crux of the reproductive system, and dealing first with the Japygidæ and the primitive Pterygota, we are led to the conclusion that the Thysanura-Pterygota line originally possessed eight pairs of gonads segmentally arranged, of which one pair has been lost in the

Japygidæ. Counting thoracic and abdominal segments all as postcephalic, the most posterior position of the gonopores in Progoneate types is the *fourth postcephalic segment*, while the most anterior position in Opisthogoneate types is actually the *eighth, in Collembola*. Thus both types can be simply derived from an original ancestor *which possessed only five pairs of gonads*, in the fourth to eighth postcephalic segments respectively. These must be conceived of as having originally opened segmentally by paired gonopores. The linking up of the gonads on each side by paired gonoducts, to open into the fourth postcephalic segment only, gave the primitive progoneate condition, while a similar linking, with backward opening into the eighth, gave the primitive opisthogoneate condition, as in Collembola.

The conclusions arrived at by the above three lines of analysis are so closely similar that it is possible to exhibit them all in a single phyletic diagram (Fig. 1). The original common ancestor of myriopods and insects must have differed from the Onychophora in not being epimorphic and in having fewer body segments. This common ancestor, the Protaptera, would have merited the status of a class. It divided, first of all, into progoneate and opisthogoneate forms ; and, very soon after, the opisthogoneate types divided into Myriopoda Opisthogoneata and true Insecta or Hexapoda. The Collembola are the only remaining remnant of all the ancient protomorphic types. They were quite well developed in the Lower Devonian. The progoneate types culminated in the higher diplopods, leaving the pauropods on one hand and the Symphyla on the other as lowly anamorphic types. The opisthogoneate myriopods ran out into the higher Chilipoda, which are epimorphic ; but, while still anamorphic, they gave rise to another highly evolved type, the Schizotarsia, with annulate legs and large compound eyes. The hexapod or insect line, leaving the Collembola and Protura far behind as lowly side-branches, ran rapidly through the Thysanura Entotrophica to the Thysanura Ectotrophica, and so to the winged forms of Pterygota, probably somewhere in the Carboniferous.

The probable geological horizon of the hypothetical ancestral Protaptera is Upper Silurian, and their ecology is that of terrestrial forms dwelling in moist places and feeding on primitive plant life.

Progress in Education and Research in Agriculture and Fisheries.

INCREASING recognition is being given to the fact that many problems connected with agriculture need the help of the trained research worker as well as that of the practical man. During the last twenty years, since the appointment of the Development Commission, steady and rapid progress has been made, until at the present time the ramifications of the system of research and advisory work set up by that body extend over a surprising variety of problems. Three reports recently issued, one by the Development Commissioners, and two by the Ministry of Agriculture on agricultural research institutes and research and education respectively, present a comprehensive picture of the existing state of affairs in Great Britain.

The report of the Development Commission* falls into four sections, the first two of which relate to the grants which have been recommended for the development of agriculture, rural economy, fisheries, and harbours, and describe the purposes for which these advances are being used. The third part of the report relates to action taken under Part 2 of the Act of 1909 in connexion with the compulsory acquisition of land for road improvements. The fourth part deals with the financial position of the Development Fund at the end of the year 1929–30. The advances recommended from the fund amounted to £721,653, as against £394,752 in the previous year. The large increase for agriculture and fisheries is attributable to recommendations for capital expenditure out of a special grant of £500,000 made for unemployment relief. Schemes relating to fishery harbours and reclamation are receiving special attention, and any economic schemes of reclamation which may be put forward will receive favourable consideration.

Among the activities of the Commission, those dealing with the development of the countryside make a wide appeal. Rural industries are being aided and developed in thirteen counties by means of grants to be expended according to local needs for the organisation of classes and the staging of exhibits at shows. Some counties now have permanent showrooms for exhibiting craftsmen's goods. The building of village halls is much encouraged by a system of loans which has now been thrown open to the whole country by the establishment of *ad hoc* committees in counties not having a community council. The success of the scheme is such that in the first three months of 1929, 279 villages made inquiries as to loans, and during that period fourteen loans, amounting in all to £3833, were approved.

Another feature of the year's work of the Development Commission has been the adoption of methods for the relief of the fishing industry by remission of debts and by reconditioning of harbours with the view of the development of fisheries. A total sum of £34,770 was recommended during 1929–30 for the maintenance of fishery research. The grants are for 'directed' researches, deliberately planned to find a solution of problems affecting the commercial fisheries, and 'free' researches, the object of which is to advance that knowledge of marine life in relation to its whole environment upon which the solution of practical problems ultimately depends. The fisheries section of the report sets forth much interesting information, and is calculated to surprise the average reader by the

* Development Commission. Twentieth Report of the Development Commissioners, being for the Year ended the 31st March 1930. Pp. 247. (London : H.M. Stationery Office, 1930.) 3*s*. 6*d*. net.

extent and variety of the attempts to improve our knowledge of matters appertaining to the important sources of food in river and sea.

The position of affairs relating to agricultural research is set out more fully in the report issued by the Ministry of Agriculture and Fisheries.* Here, again, it is obvious that a very wide field is being surveyed, and that a multitude of problems relating to agriculture in the widest sense are being probed. These investigations are nearly all carried out at the research institutes and at advisory centres, by specially appointed staffs. It is scarcely possible to give even the briefest outline of the activities of the stations, which range from every aspect of plant and animal growth in health and disease to problems of agricultural economics, engineering, food preservation, and transport. The main lines of research in progress are indicated in a series of short reports drawn up by the heads of the various institutes, but of necessity they can do little more than indicate the object of the experimental work and the more striking of the results already obtained. It is apparent that steady progress is being made and much valuable information obtained and disseminated, the output apparently being limited only by the staff and money available. The attempt to establish *Spartina townsendii* (rice grass) in Essex is interesting. The primary object is to prevent coast erosion, other considerations being the provision of a supply of seed to meet overseas demands and the establishment of a crop which could be used as an emergency feed for stock and to provide material for examining other economic possibilities of the plant. Attempts at overseas transport have shown that seed is unsatisfactory for long journeys involving passage through the tropics, but that cuttings can be successfully carried so far as Singapore if shipped in cool chambers between 30° and 40° F.

Fluctuations in the number of wild rodents are of importance on account of the economic effects of these animals on agriculture and forestry. The co-operation of numerous observers throughout the country has been enlisted to obtain data about cycles in numbers of field mice and squirrels, the cyclical variation being apparently affected by disease and by certain climatic factors as yet not properly understood.

The other report issued by the Ministry of Agriculture and Fisheries† indicates a gradual but steady expansion of the system of agricultural research and education in Great Britain, this being regarded as convincing proof that a genuine need of agriculture in the country is being met by this means.

Agricultural research owes much to the financial aid received from the Empire Marketing Board, which has facilitated considerable extension during the past few years. In 1929 the expenditure on research from all sources amounted to £19,694 on capital account and £288,012 for maintenance grants, more than half of the expenditure taking the form of grants to research institutes. The most important single development has been the formation of eight Imperial bureaux, which have been established in close connexion with existing research institutes. These deal with soil science, animal nutrition, animal health, animal genetics, agricultural parasitology, plant genetics (herbage plants and others), and fruit production. It already seems certain that the opportunities thus afforded for mutual interchange of ideas and information will benefit British agriculturists as well as overseas workers.

Attention is directed to the serious scarcity of students, trained in biological science, capable of filling the various posts in the Empire which from time to time offer themselves; special steps have since been taken to attempt to remedy this by increased publicity of the possible opportunities awaiting trained biologists.

The report, as a whole, confines its attention to an outline of the position of the Ministry's various activities with regard to agricultural research, local investigations and advisory work, scholarships, and provision of technical advice. Detailed accounts of the scientific results are not included, as they are published elsewhere.

Agricultural education during 1928–29 continued to make steady progress, but showed no features of outstanding importance. Special attention was devoted to the problem of providing suitable agricultural instruction for country boys and girls between the ages of fourteen and sixteen years, and certain experimental courses in Shropshire met with such success that the possibility of more extended schemes has come under consideration. Further success has attended the Ministry's recognition of farm household management as a branch of agricultural education, scholarships being provided at certain institutes.

Improvements in the position of veterinary science are overdue, and proposals have been put forward for the reconstruction of the Royal Veterinary College with the view of establishing the work on a sound basis, the recommendations being very far-reaching.

The progress of dairy education is reflected in the rapid improvement in the milk supply throughout England, the producer, on the whole, turning out a much higher grade product than formerly. As a result, the interest of sanitary inspectors has been aroused, and many of these are endeavouring to keep in touch with the dairy instructors.

Horticultural education is steadily increasing, and during 1929 two more county authorities began to provide facilities in this respect. A noteworthy advance has been made with regard to instruction in the cultivation of crops under glass, as complete courses of practical and technical instruction for the commercial glasshouse industry have been established by the Herts education authority, in co-operation with the Lea Valley Growers' Association. Bulb-growing provides an example of a

* Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1928–29. Pp. 247. (London: H.M. Stationery Office, 1930.) n.p.

† Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1928–29. Pp. 100. (London: H.M. Stationery Office, 1930.) 1*s.* 6*d.* net.

highly specialised industry which is benefiting by county and Government assistance, comprehensive trials and experiments dealing with problems peculiar to the industry being carried out in various centres, notably Scilly, Cornwall, and Lincolnshire.

On the advisory side, continued progress has been made in the inspection and certification of growing crops, chiefly potatoes, strawberries, and black currants; of goods intended for export, including nursery stock; and in the enforcement of the various orders against destructive insects and pests. The value of this phase of work is enhanced by the stringent import regulations in force in many other countries, as it is most important that the high reputation of the English certificate of health should be maintained. W. E. B.

News and Views.

THE following sectional presidents have been appointed for the centenary meeting of the British Association, to be held in London on Sept. 23–30 next year, under the presidency of General Smuts: Section A (Mathematical and Physical Sciences), Sir J. J. Thompson; Section B (Chemistry), Sir Harold Hartley; Section C (Geology), Prof. J. W. Gregory; Section D (Zoology), Prof. E. B. Poulton; Section E (Geography), Sir Halford Mackinder; Section F (Economic Science and Statistics), Prof. E. Cannan; Section G (Engineering), Sir J. Alfred Ewing; Section H (Anthropology), Prof. A. R. Radcliffe-Brown; Section I (Physiology), Dr. H. H. Dale; Section J (Psychology), Dr. C. S. Myers; Section K (Botany), Prof. T. G. Hill; Section L (Educational Science), Sir Charles Grant Robertson; Section M (Agriculture), Sir John Russell. On Wednesday, Sept. 23, the ceremony of installing General Smuts as president of the Association, and a reception of delegates, will be held in the Albert Hall during a private view of the exhibition which is being arranged in connexion with the Faraday centenary celebrations, and will be open, for this occasion, to members of the British Association.

DYESTUFFS have occupied considerable attention in Parliament recently, the debates incidentally directing the limelight of public attention on to the part played by organic chemistry in framing the nation's destiny. In the House of Commons on Dec. 17, the Government's majority in favour of allowing the Dyestuffs (Import Regulation) Act, 1920, to lapse next month had fallen from thirty to six—a small number, seeing that 482 members voted, but sufficient to reject the amendment inserted by the House of Lords in the Expiring Laws Continuance Bill. Mr. Graham, the President of the Board of Trade, disagreed with the view that opportunity for further inquiry was necessary, holding that there has already been made a full and impartial review of the case by the Dyestuffs Industry Development Committee, which was representative of both dye manufacturers and dye users. This committee was unable to give any clear direction to the Government; the decision of the latter, he said, was well founded and should be maintained. Sir P. Cunliffe-Lister said that the committee's report urged the Government to pursue inquiries further and endeavour to reach agreement between makers and users as to the measure of protection necessary and the form which it should take. He challenged the Government to disclose the views of the Service departments, and declared that a substantial section of dye users opposed the lapse of the Act. Sir H. Samuel again opposed the continuance of the Act; is there any probability, he asked, that a new inquiry will lead to any more agreed and unanimous a report than that which has already been issued?

LABOUR members were not solidly ranged in support of the Government's attitude; Mr. Wise, Mr. Denman, Major Church, and Mr. Strachey advised acceptance of the Lords' proposal to continue the Act for one year. Mr. Wise expressed his belief that the growth of the dyestuffs industry in Great Britain has had very valuable effects on research, but he doubted whether all is being done that might be expected. It would be in the best interests of British industry and the vital interests concerned in dyes and chemicals if the Act were continued for a short period. Mr. Denman said that we need more experiment; we have shown ourselves intolerant of experiments and drop them at the moment when they are becoming interesting and worth continuing. He advised a test of the new conditions, followed by an inquiry, before a final decision was reached. Major Church said that virtually every scientific body in the country has condemned the non-continuance of the Act. With one accord eminent scientific workers at the Bristol meeting of the British Association last September suggested that it would be an act of incredible folly to withdraw the protection which has been given to our dye industry, and he did not think the House could afford to ignore the considered opinion of that body. Mr. Strachey declared that if Britain is to survive as an industrial nation, it will be primarily by the development and application of science throughout the industrial and economic system, and the action of the Government would attack the interests of science both directly and indirectly by allowing the Act to lapse. Speeches in favour of temporary continuation of the Act were delivered by Mr. Remer, Sir H. Croft, Mr. Marjoribanks, Mr. E. D. Simon, and Sir R. Horne, whilst Mr. J. H. Hudson, Sir D. Maclean, and Mr. Shaw opposed it; the Secretary of State for War (Mr. Shaw) admitted that the experts in his department advised that it is essential to maintain a chemical research industry, and that, failing it, there must be something comparable to safeguard the country.

INSISTING on its amendment, which has the effect of continuing the Dyestuffs (Import Regulation) Act for another year, the House of Lords on Dec. 18 returned the Expiring Laws Continuance Bill to the

House of Commons. It was admitted, said Viscount Hailsham, that dye-making is an industry of national importance, that the dye-makers are supported by the Institute of Chemistry and the Federation of British Industries in anticipating that lapse of the Act would check research and undermine the economic position, and that the Government's advisers on matters of national security consider that the lapse would be attended by danger. Lord Parmoor voiced the Government's protest, while Lord Darling reiterated that the question is one of the safety of the country. The subsequent debate in the House of Commons, which terminated with the acceptance of the Lords' amendment, disclosed little of scientific interest; it was concerned rather with views on the relations between the two Houses, with the organisation of the dyestuffs industry, with allegation and retort. The series of debates in Parliament has perhaps served a useful purpose other than that which necessitated it. The public has been reminded that organic chemistry stands in a unique and responsible position on the quarter-deck of the ship of State. Lip service at least, and perhaps a worthier tribute, has been rendered to the claims as well as to the achievements of research. All parties agreed that chemical research must go forward in support of industry and of defence; there were even references to the reasonableness of paying for such research as is desired. We hope that, in the comprehensive inquiry which will in due course be held, the voice of chemical science will be heard as attentively as that of economics.

THE birthday anniversaries of three veteran workers in science and educational progress are called to remembrance this month. On Dec. 12 last, Prof. W. C. Unwin, "a master and teacher of the science of engineering"—to use the appraising words of the late Sir William White—entered on his ninety-third year. He was born at Coggeshall, Essex, in 1838, educated at the City of London School, and began his notable technical career as a pupil in the firm of William Fairbairn, Manchester. Prof. Unwin was elected to the fellowship of the Royal Society in 1886. Dr. William Garnett, who was born at Portsea, will celebrate his eightieth birthday on Dec. 30. Like Prof. Unwin, he was educated at the City of London School. Proceeding to St. John's College, Cambridge, he graduated fifth wrangler. Entering the Cavendish Laboratory, Dr. Garnett enjoyed the distinction of being the first demonstrator of physics there under James Clerk Maxwell. From 1904 until 1915, Dr. Garnett was educational adviser to the London County Council. Prof. S. H. Vines, who was elected a fellow of the Royal Society in 1885, will be eighty-one years of age on Dec. 31. A graduate of Christ's College, Cambridge, he was formerly Sherardian professor of botany in the University of Oxford.

THE centenary of the birth of the British chemist, Augustus Matthiessen, which occurs on Jan. 2, recalls a career successfully devoted to science in spite of great physical infirmity, but one which came to a close all too soon, in tragic circumstances. Born in London, Matthiessen's life-long defect was due to a paralytic seizure in his infancy. From an early age, however, he displayed a taste for chemistry and at the age of twenty-one was able to go to Giessen, and later on to Heidelberg, working under Will, Buff, Bunsen, and Kirchhoff. Graduating Ph.D. at Giessen, he became known for his isolation of pure calcium and strontium by electrolytic means and for his study of electrical conductivity. Returning to London, he continued his studies under Hofmann, fitted up a laboratory at 1 Torrington Place, and from 1862 until 1868 was lecturer in chemistry at St. Mary's Hospital and after that lecturer at St. Bartholomew's Hospital. His work on electrical standards, undertaken voluntarily for the British Association, occupied the years 1862–1865, and in 1869 he was awarded a Royal Medal of the Royal Society for his investigations on the physical, electrical, and chemical properties of metals and alloys. For a year he was one of the editors of the *Philosophical Magazine*. He died on Oct. 6, 1870, at the early age of thirty-nine years.

A RECENT *Daily Science News Bulletin* issued by Science Service, Washington, D.C., gives a brief account of the meeting at Washington of the first Inter-American Conference on Agriculture, Forestry, and Animal Industry. At this meeting plans were discussed for protecting the great tropical forests of the Americas from careless exploitation such as has laid waste the forests of other parts of the world. It is estimated that there are some 3,000,000 square miles of forest lands in the twenty Latin republics, an area larger than the total area of continental United States exclusive of Alaska. Practically no research has been undertaken in these forests, and the estimate of the volume of timber they are said to contain (at least six thousand billion board feet) is admitted to be purely guess-work. Mr. W. T. Cox, consulting forest engineer of the Tropical Plant Research Foundation, said that "too little is yet known about the forests of tropical and sub-tropical countries". He urged extensive forest exploration aided by aeroplane, so as to obtain not only botanical information of the numerous trees but also commercial classifications. The training of young men in forestry and the development of these vast forests along scientific principles was advised.

INTERNATIONAL foresters heard something of the undeveloped state of the forests of the Latin Americas at the Forestry Conference at Rome in 1926. The proceedings of the Sub-Committee dealing with Tropical Forestry at that Conference show that there is a vast amount of information already gathered concerning some of the tropical forests, and the perusal of Stebbing's "Forests of India" would disclose the methods by which the tropical and sub-tropical forests of India and Burma have been brought under an intensive management during the past sixty years or so. At this Washington Conference other speakers dwelt upon the dangers of diseases and epidemics due to their accidental introduction, and to the necessity of organising this matter upon international lines. Prof. D. M. Matthews, University of Michigan, was more practical when he pointed out the dangers of

looking for temporary reward rather than to ultimate benefit when forests were cut down. He also directed attention to the degrade of the land which follows reckless exploitation, and the danger to agricultural areas. Others pointed out the necessity of studying the little-known or unknown timbers of this tropical forest area, "with a view to their possible uses in future decades when both Latin American countries and the United States will have to turn to these forests for most of their lumber". This shows a better realisation of the case, and the Conference to some extent grasped the present position.

THE executive of the Comité International Radio-Maritime at its meeting in Brussels in September last discussed the possibility of the transmission of pictures to ships by means of radio. On land, between fixed places, picture and facsimile reproduction is an accomplished fact, and Marconi engineers have obtained excellent results even when the places are thousands of miles apart. The technical and commercial experts recognise that such a service as the transmission of weather charts to ships' commanders for their guidance in navigation would raise considerably the factor of safety of navigation. They concluded, however, that it would be premature to undertake a service of facsimile transmission to ships at sea. Both technical and commercial difficulties stand in the way. In the present state of the system's development, the question of cost is a serious obstacle. Such a service would doubtless enable ships to make quicker voyages and appreciably reduce risk. It would supply the master of the ship with weather charts which would give him a visual indication of the weather conditions all round him. In order to justify itself, the service would have to be perfectly trustworthy and sufficiently accurate technically to ensure good reception. The apparatus, therefore, would have to be elaborate, and the weather chart service would cost probably not less than a guinea per day to shipowners. The time occupied in the transmission of a weather chart would be about twenty minutes, during which the handling of the ordinary traffic would have to be suspended. The technical difficulties that are not yet overcome are the interference from other signals and atmospherics and, in addition, the phenomenon of 'fading'. These might render maps or charts illegible in parts and even misleading.

WHEN the English railway companies were first grouped together it was expected that more satisfactory results would be obtained by shareholders, passengers, and those who use the railways for the transport of goods. According to the views expressed by Sir Philip Dawson at a luncheon of the Batti Wallahs' Society on Dec. 11, "grouping has proved to be of no good whatever". The obvious thing for the railways to do is to adopt the most modern methods whatever they may be, but instead of doing this they do nothing. He believed that if they needed the money for the good of the public the Government would be willing to guarantee the amount. The investment would be quite sound. Unlike road and other employment schemes, it would pay dividends. The electrical manufacturers of Great Britain have supplied the world with the best machinery for electric traction. There is no reason why the country should not have the best equipped electric traction system in the world. Main line electrification has proved successful in Sweden, Japan, India, New Zealand, and many other countries. Actual electrification of the railway lines is easier now than it was a few years ago because of the progress that has been made with the grid. Sir Philip Dawson believes that main line electrification will soon be embarked upon, and that such electrification will become one of the great economic factors of the future. The Southern Railway has now 300 route miles electrified, making altogether 800 track miles. In spite of road competition, the increase in passengers carried during the last year was 35 per cent. This success is due to the fact that the comfort of the passengers has been studied. The services are fast and the trains sufficiently frequent to make the consulting of a time-table unnecessary.

THE success which has followed the introduction of high voltages for the distribution of electric power has led engineers to plan the use of still higher voltages. In Germany, for example, there is a closely meshed network 4700 miles in length working at 100,000 volts. In addition, Germany has now 750 miles of overhead mains operating at 220,000 volts. Even this high pressure is not considered sufficient to transmit great quantities of energy over hundreds of miles, and 380,000-volt lines are now being considered. At present the voltage economically practical is limited by the corona losses, but this limit can be raised considerably by employing suitable cables and insulators. To test the insulators which work at a pressure of 380 kilovolts, it is found that a voltage of a million is not adequate. In *AEG Progress* for December there is a description of a two-million volt laboratory which has been erected in the Porcelain Factory of Ph. Rosenthal and Co. As two million volts will arc over a distance of 16½ feet, a very large building had to be erected. It has no windows, as all the tests are carried out in darkness so that the faintest glow may be detected. On one side of the building there is a large hole, 27 feet in diameter, for leading out when necessary a two-million volt conductor. The high pressure is produced by two transformers with their secondaries in series and their primaries in parallel. The alternator has a capacity of a thousand kilovolt-amperes at a million volts. A large amount of power is thus available. The flashovers produced by this plant make a noise like the bursting of a high explosive, and physically are very similar to lightning. To measure the voltage, spherical electrodes each eight feet in diameter are used.

THE work of draining the Zuider Zee, the great national enterprise of the Netherlands, is now in full progress (NATURE, Sept. 21, 1929, p. 446). It is estimated that when all the land considered in the scheme has been reclaimed from the sea the area of the country will be increased by about one-seventh.

The first and smallest of the four areas into which the undertaking has been divided, and comprising nearly 50,000 acres, has been provided with two pumping stations, one at Medemblik and the other at Den Oever. When the area has been reclaimed, these stations will be permanently used for drainage purposes. In the *Brown Boveri Review* for November there is an interesting account of the novel electrical equipment at the Medemblik station. At Den Oever the water is pumped out by three centrifugal pumps driven by Diesel engines. At Medemblik the centrifugal pumps are driven by three-phase motors. The station is supplied with current at 50,000 volts. Each of the induction motors driving the pumps is rated at 660 kilowatts and runs normally at 107 revolutions per minute. By electrical devices, however, the speed can be varied between 88 and 120 revs. per minute, so that the operation may always be under the most favourable conditions. Owing to their slow speed, the motors had to be constructed with 56 magnetic poles. They always run at their maximum efficiency and power factor. The electrical station has been working continuously since last February.

ON Nov. 17, there was opened at the American Museum of Natural History a new South Asiatic Hall, the stocking of which was due to the enthusiasm of two British sportsmen, Lieut.-Col. J. C. Faunthorpe and Arthur S. Vernay. The hall is a fine tribute to the art of taxidermy in the Museum and to painstaking efficiency which led to the collection in India not only of the animals themselves but also of the plants, foliage, and representative sketches which combine to give a natural setting to the animal groups. The actual work of collection has been in progress since the first expedition was sent out in 1921, and the new hall itself has been in preparation during the last five years. The exhibited series consists of twenty large habitat groups showing all the more important of the Indian mammalia, but in addition the collectors brought back about 450 specimens now in the study collections. This fine gift—for the cost of the expeditions was borne by Mr. Vernay—arose from an almost chance visit paid by the late Col. Faunthorpe to the New York Museum, when, disappointed with the Indian animals exhibited, he expressed to Prof. H. Fairfield Osborn his willingness to make efforts to replace them. Needless to say, his project received every encouragement and support, and an unequalled South Asiatic Hall is the result. The official dedication of the hall was commemorated by the publication of a large brochure containing reproductions of photographs of all the groups. It should be a useful book to the enterprising museum curator, if only because it indicates suitable landscape treatment for the surroundings of different well-known species.

SO often we have referred to the educational activities, amongst children, of certain American museums, that it is a pleasure to commend the excellent work being accomplished by some provincial museums in Britain. At the Cardiff Conference of the Museums Association in June, two papers were read on the subject of a rural museum service, pointing out what has been done, particularly at Batley and Huddersfield, and what could be done with further encouragement and help from education authorities (*Museums Journal*, November). The main theme centred round the distribution and circulation of specially prepared educational groups amongst schools; and the interest taken in the papers and in the subsequent discussion showed how keenly alive provincial museum curators are to the educational possibilities of their collections and to the need for making an impression upon young minds. In an editorial article upon the subject of rural museums for Britain, the school service is commended, but the remark is made that "it is hard to see why the teaching of children in (not from) elementary schools should be a function of museums". Of course, the use of the museum should be a function of the education authority, but by hook or by crook the museums must get a footing in the world of elementary education, and the museums service to schools, apart from its own value, is a means of demonstrating to authorities slow to realise the possibilities that it is worth while to collaborate with museums.

A LARGE collection of neolithic implements from the Cotteswolds, numbering some eight thousand specimens, has recently been acquired by the Cheltenham Museum through the generous gift of Miss E. A. Paine. The collection was formed by her brother, the late Mr. A. E. Paine, who devoted many years of his life to the study of the neolithic period in that area. The collection is fully illustrative of the development of the new stone age industries of the district, and in addition to finished implements, includes flakes, cores, and fabricators, as well as implements in various stages of manufacture. There is also a representative series of polished implements, rare from this area. In an account of the collection which appears in the *Gloucestershire Echo* of Dec. 5, it is said that the collection is the finest from the Cotteswolds in existence. Incidentally, the writer of the article states that while the Museum contains objects from the long barrows of the neighbourhood, the culture of the round barrows is not represented, although it is well known that many of these have been opened and that their contents are still in existence but are not available for study. Perhaps Miss Paine's example may stimulate one or more private owners to emulate her generosity.

DR. MARCEL FOSSEYEUX, the indefatigable general secretary of the French Society for the History of Medicine, has recently compiled and published a bibliography, arranged according to authors and subjects, of the papers read before the first six international congresses of the history of medicine, held at Antwerp (1920), Paris (1921), London (1922), Brussels (1923), Geneva (1925), and Leyden and Amsterdam (1927) respectively. The great variety of the subjects is shown by the fact that they have been classified in the following fifteen sections: (1) bibliography, terminology, inscriptions, etc.; (2) education, schools and faculties, corporations;

(3) medical doctrines, methods, and processes of examination; (4) biographies (by far the largest section); (5) history of anatomy; (6) history of diseases such as plague, leprosy, syphilis, and nervous disorders; (7) surgery, obstetrics, ophthalmology, and stomatology; (8) pædiatrics; (9) dietetics, therapeutics, pharmacology, hydrology, and climatology; (10) public health and epidemiology; (11) veterinary medicine; (12) medicine and art; (13) medicine and literature; (14) hospitals, public assistance, and military medicine; (15) folk-lore, charlatanism, mystic medicine, popular medicine, and primitive medicine.

THE November number of the *King's College Hospital Gazette* was published as a centenary number and contains a sketch of the history of the Medical School, 1830–1930, the Medical Faculty having been established the year after the founding of the College. For some years the students suffered from the drawback of having to obtain practical instruction in the neighbouring hospitals, until in 1839 the first King's College Hospital was opened upon the site of the old St. Clement Danes workhouse in Portugal Street, Lincoln's Inn Fields. One hundred and twenty beds were at once available, and by 1872 this had increased to 172. In 1909 King Edward VII. laid the foundation stone of the new Hospital at Denmark Hill, which was opened four years later. Of the many famous men who taught in the old hospital, such as Richard Partridge (1805–1873), Robert Bentley Todd (1809–1860), Sir William Fergusson (1808–1877), Sir William Bowman (1816–1892), and others, Dr. Willoughby Lyle gives many interesting notes. Fergusson, a brilliant operator, it was said 'had the eye of an eagle, the heart of a lion, and the hand of a lady'. Lister joined the hospital in 1877, and it was in the old buildings in Portugal Street in July 1892 that he delivered his last clinical lecture. Patient to a degree, he disliked carelessness, but his failing was unpunctuality. The last meeting of the Committee of Management in the old buildings was held in July 1913, and patients were admitted and work commenced in the new hospital at Denmark Hill in October of the same year.

THE sixteenth Report of the Director of Veterinary Services and Animal Industry, Ondersterpoort, Pretoria (Union of S. Africa, Dep. of Agricult.: The Government Printer, Pretoria, 1930. Pp. vi.+592), maintains the high standard of previous volumes and is admirably produced and illustrated. The Director, P. J. du Toit, and R. A. Alexander have found that it is possible to immunise horses against horse-sickness by means of formalised virus. The bacteria of botulism are surveyed at length by E. M. Robinson. Parasitology has several papers devoted to it. The important subject of mineral deficiency and metabolism as it affects animals is considered in seven communications. The production of bacon is the subject of a valuable study in which the influence of the breed of pig and variations in the feed of the animals upon the grade of bacon produced have been investigated. These papers are only a few of the studies dealt with in this volume.

AT the ordinary meeting of the Institution of Electrical Engineers to be held at 6 P.M. on Thursday, Jan. 8, an oil painting of Graham Bell, by Mr. W. W. Russell, R.A., will be presented to the Institution by Sir Hugo Hirst.

AT the recent council meeting of the Yorkshire Philosophical Society, York, Prof. G. Baldwin Brown, Watson Gordon professor of fine art in the University of Edinburgh, and Dr. R. Mortimer Wheeler, Keeper and Secretary of the London Museum, Lancaster House, were unanimously elected honorary members of the Society.

SERIOUS losses are liable to occur from certain diseases, particularly piroplasmosis and anaplasmosis, in British cattle imported into South Africa, South America, and elsewhere, and this risk acts as a deterrent to the export trade. The Ministry of Agriculture and Fisheries announces that immunisation against piroplasmosis and anaplasmosis can now be carried out at the Ministry's Veterinary Laboratory at Weybridge. For particulars application should be made to the Secretary of the Ministry, Whitehall Place, London, S.W.1.

WE learn from a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., that quarantine restrictions on Florida fruit and vegetable shipments have been wholly removed as from Nov. 15 last. These restrictions were put into force in order to protect the rest of the United States against the Mediterranean frit fly which was discovered in certain Florida orchards in April 1929. Energetic measures of repression were put into operation almost immediately the discovery was made, and these appear to have been so efficacious that Florida is now restored to complete parity with all other States so far as such shipments are concerned. The lifting of the quarantine regulations, however, does not mean that the usual vigilance will be relaxed, since the possibility has to be provided for that complete eradication of the pest has not yet been achieved.

THE Medical Research Council announces that it has awarded three Dorothy Temple Cross Research Fellowships for 1930-31, these being the first appointments to be made under the terms of the recent benefaction in that name for research fellowships in tuberculosis, as follows: Dr. A. I. G. McLaughlin, Chief Assistant, Tuberculosis Department, St. Thomas's Hospital, London; Mr. R. J. Matthews, Chief Tuberculosis Officer, Mid-Glamorgan area, and Medical Superintendent, Cymla Hospital; and Lieut. S. M. Burrows, R.A.M.C., attached Sudan Defence Force. Dr. McLaughlin has received a fellowship for the study of methods of diagnosis and treatment at some chosen centre in the United States. Dr. Matthews and Lieut. Burrows have received senior fellowships and will make special studies of problems of tuberculosis among the native population in Zanzibar and in the Bahr-el-Ghazal Province of the Sudan, under arrangements made by the Council with the respective governments.

AN important catalogue (No. 440) of some 2000 second-hand books on zoology, geology, and palæonto-

logy has just been received from Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1. Many rare works are included.

MESSRS. A. West and Partners, 36 Broadway, Westminster, have recently issued a catalogue of 250 pages, of surveying and drawing instruments, with sections devoted to photographic apparatus and plan reproduction materials. Besides the usual apparatus and fittings, there are described a new form of cabinet for filing plans by hanging them in steel clips; a computing board designed by Mr. R. O. Kapp for calculations of two-part tariffs involving the four quantities—the kw. charge, the unit charge, the load factor, and the total cost per unit; and the Bromostat method of reproducing plans.

MESSRS. C. F. Casella and Co., Ltd., have recently issued a new edition of their illustrated Catalogue of Surveying and Drawing Instruments, including theodolites, transit instruments, levels, barometers, telescopes, tide gauges, planimeters, etc. Besides giving the dimensions and prices of the instruments, notes are given on their construction and, in some cases, on their use also. Included in the catalogue are the prism attachment for use with theodolites for the observation of equal altitudes, designed by Mr. E. A. Reeves, and the prism alidade, devised by the Rev. A. J. Potter, an instrument depending on a simple optical principle, which does not appear to have been used in this connexion hitherto. A new form of cathetometer is described; while among the barometers shown is an interesting reproduction of an instrument made about 1690 by Tompion, "the father of English clockmakers", who, it will be recalled, lies in the nave of Westminster Abbey, in the same grave as his famous apprentice, George Graham.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant agricultural chemist in the Department of Agriculture and Horticulture of the University of Bristol—The Agricultural Advisory Office, 22 Berkeley Square, Bristol (Jan. 3). A visiting teacher of mathematics for the Paddington Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (Jan. 5). A graduate assistant master for physics at the Middlesbrough Junior Technical School—The Director of Education, Education Offices, Middlesbrough (Jan. 5). A principal of the Torquay Technical College—The Secretary, The Castle, Exeter (Jan. 8). Civilian education officers, Grade III., in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1 (Jan. 17). A professor of geology at the University College of Wales—The Financial Secretary, University College of Wales, Aberystwyth (Feb. 14).

Our Astronomical Column.

Pluto.—As noted in NATURE for Sept. 27, Prof. M. Wolf found an image on a plate exposed at Königstuhl on Jan. 23, 1914, which was conjectured to be Pluto. A comparison made by Messrs. Bower and Whipple with their ephemeris in *Lick Obs. Bulletin*, No. 427, gave residuals of $-112{\cdot}5''$, $-25{\cdot}2''$ in R.A. and Decl., so that the identity appeared doubtful (*Harv. Circ.*, 142). But in *U.A.I. Circ.*, 305, Dr. Zagar publishes new elements of Pluto, in which he has applied perturbations by all the large planets, so that they should be somewhat more exact than the Lick elements (the difference between them is not great). The new elements represent the 1914 position within $0{\cdot}6''$, so that there is little doubt that it belongs to Pluto. It extends the arc of observation by nearly six years, the previous date of the earliest images being December 1919 (Mt. Wilson).

Prof. H. N. Russell discusses the orbit of Pluto in the *Scientific American* for December. He considers the resemblance to the predicted orbit of Prof. P. Lowell to be far too close to be ascribed to chance, and concludes that it is the planet to which Lowell's analysis pointed. He also makes some interesting comments on the relations of Pluto to Uranus and Neptune. It takes about 500 years for Neptune to gain a revolution on Pluto, so the two planets will not be so near to each other for 500 years as they were at the conjunction a few years ago. It will be some 9000 years before the two planets will be at their minimum distance from each other, which is about $2\frac{1}{2}$ astronomical units. Pluto comes slightly inside Neptune's orbit, its perihelion distance being 29·80 units, but its high inclination (17° 7′) prevents a very near approach. Zagar's date for the next perihelion passage is 1989 Aug. 28·72; Lowell predicted March 1991.

Masses and Rotations of Planets.—Mr. V. V. Nariker, 136 Victoria Road, Cambridge, notes in a letter to the Editor that if the planets are arranged in order of angular velocity of rotation, we get nearly the same order as when they are arranged in order of mass, the larger masses having the smaller periods of rotation. He observes that this may throw some light on the origin of the planetary system, as the orbital speeds of particles near a large mass would be higher. It is doubtful whether much stress can be laid on his result. The difference of angular velocity of the four giant planets is very small compared with their difference of mass; further, Neptune, though more massive than Uranus, has a slower rotation. At least two of the inner planets, the earth and Mercury, have had their angular velocities diminished by tidal action, so that their present rotations are not much guide to the primitive ones. Still, the point is worth mentioning, as it may be one of the many factors on which the early rates of rotation depended. The masses of the asteroids are very small; still, many of them are inferred to have rapid rotations from changes in their light.

The Leonid Meteors.—The date of the next expected maximum of the Leonid meteors is now approaching, being due in 1932 or 1933. The *Daily Science News Bulletin* of Nov. 18 and Nov. 21, issued by Science Service, Washington, D.C., states that the meteors this year were more numerous than was expected, the display being the best since 1901. Dr. Olivier states: "It was much better than we expected and greatly encourages us to think that there may be a great shower in two or three years". The maximum occurred on the early morning of Nov. 17, which was a day later than he expected; the hourly rate was two or three times as great as he expected, and many of the meteors were fire-balls with long-enduring trains.

It is extremely difficult to make accurate forecasts for meteors, as their orbits are not identical with that of the parent comet; further, those that we meet in any year have never been seen before, so we can only guess at their position, knowing that of other meteors at a considerable distance from them.

Research Items.

Peruvian Weights.—In *Man* for December, Erland Nordenskiöld discusses the ancient Peruvian system of weights on the evidence of two collections of stones presumed to be weights. Although individual objects regarded as weights have previously been described, this is the first account of any series from which some idea of the Peruvian system might be deduced. The first series is from the collection of Dr. E. Gaffon in Berlin. It comprises 13 stones and was discovered in the Hacienda de Sagrario, near Huacho. With the series was a small beam balance and a basket-work case. The weights were enclosed in a neatly finished cloth bag. With one exception the weights are water-polished pebbles; the exception is said to be of meteoric iron. The stones fall into two series, one of four stones, the other of nine. When the series of nine is arranged according to weight, it appears that the heaviest is eighteen times the weight of the smallest, the intervening units being 3, 5, 10, 12, 15, and the aggregate sum of all the units 85. The weight of the smallest is 1·53 gm., of the heaviest 27·50 gm. In the series of four, the largest again appears to equal eighteen units of weight, weighing 29·17 gm., and the smallest five units, at 8·10 gm. This system appears to show Spanish influence. The author, however, believes he has discovered in the collections of the Gothenburg Museum a series which is uninfluenced by the Spanish system, in a number of stones contained in a cloth bag from Pachacamac. In this series of nine stones, five suggest a unit between 3·72 gm. and 3·86 gm., while the remaining four, if taken in pairs, probably constitute units in the same system. There again occurs a weight which is eighteen times the unit, and it is, therefore, suggested that the figure 18 in the previous system is a survival of the ancient and original system. It may be due to the necessity of measuring some compound in which one of the ingredients had to be eighteen times another—such, for example, as the proportion of copper to tin in making bronze (5-6 per cent of tin in the Inca bronzes).

Excavations in Syria.—The results obtained in 1929 and 1930 by the French archæological expedition to Syria of the Académie des Inscriptions et Belles Lettres are described by M. Schaeffer, the leader, in the December issue of *Antiquity*. The work was begun as the result of the accidental discovery of a burial vault at Minet el Beida which contained Mycenæan and Cypriote pottery dating from the thirteenth century B.C. The excavations on this site have revealed an important cemetery containing several large rectangular tombs with corbelled vaults, approached through a short vestibule with stairway, the whole being built of well-worked stone blocks. One of the tombs was hidden under an important building and other more important buildings connect directly with the tombs. One building cleared this year contained thirteen halls, rooms, and passages, without counting the upper story, the staircase and landing of which are preserved. North of the tombs, towards the sea, at a depth of between 0·50 m. and 1·50 m. lay about eighty deposits of Mycenæan, Cypriote, and local pottery, bronze implements, and a variety of other relics, some of Egyptian provenance, and including statuettes of Syrian and Egyptian deities. A large temple on the northern projection of the mound had two rectangular courts joined together and enclosed by thick walls. The name of the town, Sapounna, was recovered from one of the stelæ. Near by was a seminary for priests, equipped with a library with numerous inscribed tablets. Outstanding importance is given to the cuneiform tablets by the fact that most of them contain a script that is wholly unknown and had already become alphabetic. In the glossaries Sumerian is translated into a language at present unknown, instead of the usual Babylonian. From the important finds made to date, it is clear that Sapounna was an international commercial centre of first-rate importance, with a polyglot population whose priests must have spoken at least five languages, including that which is at present unknown to us; while in the pantheon, native Syrian deities appear side by side with those of Mesopotamia and Egypt.

Abnormal Incisor in a Coypu.—An abnormal incisor of *Myocastor coypus*, which recalls some of the examples in other mammals recently described by Prof. W. C. M'Intosh, is described and figured by Carlos Rusconi (*Physis: Rev. Soc. Argentina Cien. Nat.*, **10**, p. 162; 1930). In the degree of its abnormality this upper tooth is unusual, for, having been deflected off the line of its opposing incisor in the lower jaw, it has continued to grow until the tip has described a full circle and more. The usual length of the incisor of a coypu is 76 mm.; this one measures 156 mm.

Fresh-water Sponges from the Dutch East Indies.—Mr. N. Gist Gee, in *Treubia* (vol. 12, 1; 1930), continues his work on fresh-water sponges, the first part of which contained an historical account (*Treubia*, vol. 11, 2; 1929). The present part provides descriptions and illustrations of a very large number of species. Fresh-water sponges are abundant in these regions, occurring in lakes, tanks, ponds, and running water, and many of them are described from living material; this gives much value to the work, for colour, form, and habit are specially noted, in addition to the spicules both of the sponge itself and of the gemmules. We have now a very good idea of the fresh-water sponge fauna of the Dutch East Indies, which is of considerable importance.

North American Retinellidæ.—After careful study of the anatomy of most of the species, H. B. Baker has attempted to classify the North American land snails of the genus *Retinella* (*Proc. Acad. Nat. Sci. Philad.*, vol. 82). Previous classifications based on the supposed presence or absence of an accessory left mantle-lappet are inaccurate, the structure being present in all. It seems that *Retinella*, *Glyphyalinia*, *Omphalina*, *Mesomphix*, and *Vitrinizonites* have two widely separated lappets on the left side of the mantle edge, but *Oxychilus* and *Zonites* have only one continuous lappet in that position. The shell characters that may be used for the distinction of species are growth sculpture, spiral striæ, and form of shell. A systematic list with localities and notes of the species of the genus form the bulk of the paper, which also includes descriptions of the new subgenera *Glyphyaloides* and *Glyphognomon*.

The Foraminiferal Family Polymorphinidæ.—In "A Monograph of the Foraminiferal Family Polymorphinidæ, Recent and Fossil" (*Proc. U.S. Nat. Mus.*, vol 77, pp. 1-195, pls. 1-40; 1930) Dr. J. A. Cushman and the late Dr. Y. Ozawa describe and figure all the species of the Polymorphinidæ. The first undoubted representatives are found in the Trias, but it is not until the Jurassic that the family becomes at all frequent. The affinities of the species which have been recorded from the Ordovician and the Devonian are uncertain. With regard to distribution, the authors state that smooth and rather primitive species have a long geological history and are widely distributed, whereas specialised forms are restricted to narrow limits both in the present oceans

and in the past. Similarly, some of the species of various genera that are highly ornamented or have very characteristic shapes do not range widely. In their remarks on the evolution of the family, it is stated that the Polymorphinidæ are certainly derived from some coiled form of the Lagenidæ such as *Marginulina* or *Vaginulina*. Many species are described or recorded from various horizons in the Jurassic, Cretaceous, and Tertiary formations of England.

Researches on *Caudina chilensis*.—This organism is a favourite subject for research, and is used in two interesting papers in the June number of the *Science Reports* of the Tôhoku Imperial University (Fourth Series—Biology), Sendai, Japan, vol. 5, No. 2, 1930: "Notes on the Development of a Holothurian *Caudina chilensis* (J. Muller)", by Densaburo Inaba, and "On the Circulation of the Perivisceral Fluid in *Caudina chilensis* (J. Muller)", by Masayasu Zazabi. The first describes the development from egg to larva and young stages, the work being carried out both on material reared from artificial fertilisations and on eggs and larvæ from the plankton. The Auricularia stage is omitted and the barrel-shaped larva is a Doliolaria, which is also the case in several cucumarians the development of which is known. The life-histories of members of the family Molpadiidæ, to which *Caudina* belongs, have not so far been investigated, and it is shown that it is more closely related to the Cucumariidæ than to the Holothuridæ or Synaptidæ. The breeding season at Asamuchi, where the work is carried on, is in May and June, spawning taking place during the high tide which succeeds the day-time low tide. The structure of all the stages in development is carefully worked out and there are good diagrammatic text-figures and six plates. The second paper, dealing with the pericardial and the tentacular fluid in *Caudina*, shows that the current of the former progresses antero-posteriorly close to the body wall and returns postero-anteriorly along the centre of the body cavity. The pressure of the perivisceral fluid exhibits much variation and is much higher in adults than in the younger animals in a similar physiological state.

Genetics of Garden Beans.—There are many varieties of the garden bean, *Phaseolus vulgaris*, differing markedly in the colour and mottling of the seed, in flower colour, and in other characters. K. Miyake, Y. Imai, and K. Tabuchi (*Jour. Coll. Agric. Imp. Univ. Tokyo*, vol. 11, No. 1) have made a further study of the genetics of stem and flower colour, seed-coat colour, and pattern. They find pink stem recessive to red, the flower colour corresponding in each case, while green stems may bear flowers which are red, pink, flecked, or white. Varieties with flecked or white flowers always have green stems, but when these are crossed the stem is coloured. Red stem is epistatic to pink, and coloured stem is dominant to green. Pink × green stem gives red F_1 and in F_2 9 red : 3 pink: 4 green, showing the presence of two factors. As regards seed colour, black is found to be epistatic, and white hyperstatic to all others. Intermediate in the series are brown, purple, red, grey, and yellow, each apparently represented by a single gene. Piebald is recessive to self-colour, and there are three possible modifiers affecting the extension of the colour. The 'mottled' character is dominant and is linked to the recessive gene cream, with which it gives 2·6 per cent of crossing-over. The various types of bean studied are illustrated by two coloured plates.

Base Line Comparisons.—The Baltic Geodetic Commission has recently issued its first Special Publication (No. 1, Helsingfors, 1930, pp. 236), which is entitled "Measuring of Seven Base Lines of the Baltic Polygon, executed in the year 1929", by Ilmari Bonsdorff. The aim was to determine whether the base lines in the various countries surrounding the Baltic Sea, and partaking in the work of the Geodetic Commission, are really in agreement with one another. The seven base lines chosen were Szubin (5·1 km.) in Poland, Sveksna (6·5 km.) in Lithuania, Ösel (6·3 km.) in Estonia, Hanko (5·9 km.) in Finland, Enköping (6·9 km.) in Sweden, Öland (6·0 km.) in Sweden, and Lolland (6·8 km.) in Denmark; these were compared with the standard bases at Potsdam (240 metres) and Helsingfors (720 metres). Eight invar wires were used; four were Finnish and four Danish, and as their certificates indicated that their temperature coefficients were different, they were supposed to be drawn from different pieces of invar; it was found later that one set of certificates gave wrong values, and that all the wires were really drawn from the same piece. Afterwards it appeared that between the second and third measurements at Helsingfors all the eight wires lengthened by 0·082 mm., for no assignable cause. This seems to be the most serious cause of error in such geodetic measurements, apart from irregular lateral refraction depending on climatic conditions.

Echo-Sounding.—The depth shown by an echo-sounding machine requires correction for the slope of the bottom, since the strongest echo, which makes the record of the depth, is returned as a rule from the nearest point, which is not always vertically under the ship. A. L. Shalowitz (Slope Corrections for Echo Sounding: U.S. Coast and Geodetic Survey Special Publication, No. 165) considers that this correction is negligible if it is so small that the uncorrected sounding would be correct if displaced on the chart by a distance not greater than the width of the numerals expressing it, 0·16 inch on an American chart, and provides tables for the rapid recognition of such cases. At least two lines of soundings are required in order to determine the slope correctly. An objection to this suggestion is that a sounding would be entered uncorrected on a chart on a small scale but corrected on one on a larger scale. The paper is reprinted in the *Hydrographic Review*, vol. 7, No. 1 (Monaco 1930), which contains a number of original papers and reprints or abstracts from other journals. Among the original papers is a note, with illustrations, on the British Admiralty pattern echo-sounders for 250 fm. and 500 fm., made by Henry Hughes and Son; and in other papers reference is made to the Langevin echo-sounding apparatus used in Italian surveying ships, and the French Marti apparatus. E. Lübcke in a reprint recommends the use of the Admiralty "Tables of the Velocity of Sound, etc.", H.D. 282, for the reduction of soundings to be used for scientific purposes, but prefers a standard velocity of 1500 metres per second for practical purposes. M. Camille Vallaux discusses the present state of our knowledge of the Humboldt Current, and accepts the view that the cold greenish water rich in diatoms wells up from the continental slope, while the occasional patches of cold blue water come from greater depths. Capt. J. Luymes, of the Netherlands Hydrographic Office, gives a short history of oceanography, with a postscript dealing with the work of the *Willebrord Snellius* Expedition up to the end of the year 1929.

Fluid Flow at Corners.—The issue of the *Canadian Journal of Research* for September contains a contribution from the National Research Laboratories, Ottawa, dealing with the design of corners in fluid channels so that they may produce the minimum of disturbance of the uniformity of flow. The authors, Messrs. G. J. Klein, K. F. Tupper, and J. J. Green, by observations on the air flow in a wind tunnel 18 inches wide, bent at a right angle, find that strips of thin

metal a little more than an inch in width bent so that half their width is at right angles to the other half, and placed in the diagonal of the bend of the wind tunnel with their surfaces parallel to the two directions of flow, make a great improvement in the uniformity of the downstream flow. Strips of the same width bent so that their transverse section is a quarter of the circumference of a circle, and placed about half their width apart along the diagonal of the bend, produce a downstream flow which is very nearly uniform across the width of the tunnel. The authors point out that the same improvement may be made in the uniformity of the downstream flow in bent water- or steam-pipes in which the resistance has to be reduced to a minimum, by the introduction of bent vanes.

Joule's Thermometers.—The November issue of the *Journal of Scientific Instruments* contains a short note by Dr. J. R. Ashworth on the present state of two of the thermometers used by Joule in his researches on the mechanical equivalent of heat which are preserved in a wall case in the rooms of the Manchester Literary and Philosophical Society. The two are the *A* and *D* instruments mentioned by Joule in his paper in the *Transactions* of the Royal Society of 1850 as those with which his most accurate work was done, *A* being the calorimeter thermometer. Each was made by Dancer of Manchester in 1843, and is nearly a metre in length, with a spheroidal bulb and an arbitrary scale, the range of *A* being from 0° to 30° C., and of *D*, 0° to 100° C. Joule calibrated both and recorded the changes of the freezing-point readings on them from 1844 to 1882. Sir Arthur Schuster tested them again in 1892, 1893, and 1894, and Dr. Ashworth has again tested them this year. During the whole period the freezing-point records have risen; in the first six years *A* showed a rise of 0·33° C., and it is now 0·65° C. and appears to be approaching a limit exponentially. It would be interesting to know what other thermometers of this age are in existence, and how their freezing-point readings have changed since they were first determined.

Sulphur Hexafluoride.—The compound SF_6, discovered by Moissan in 1886, is of interest because in it sulphur is exerting its maximum valency and the resulting compound is chemically very inert. Shumb and Gamble, in the November number of the *Journal of the American Chemical Society*, describe the preparation of the compound from sulphur and fluorine (the only practical method), in the course of which they give details of a simple apparatus, in which monel metal was used, for the production of fluorine. The vapour-pressure curve, melting point (−50·8°), and gas density (5·10 when air = 1; theoretical 5·04) were investigated.

Oil-driven Locomotives.—To the valuable series of pamphlets issued by the Association of Engineering and Shipbuilding Draughtsmen has recently been added one on the internal combustion engine, by B. Reed. In England, America, Germany, Switzerland, Russia, and elsewhere, much experimental work is being done on oil-driven locomotives, and Mr. Reed's paper contains a review of the problems involved in the design of locomotives fitted with Diesel engines and many particulars of the oil-driven locomotives at work. The fuel consumption of a Diesel engine for traction purposes is about 0·43 lb. per b.h.p. per hour, but taking coal at 22*s.* 6*d.* per ton and Diesel oil at 90*s.* per ton, the thermal efficiency of the oil-driven locomotive must be at least 3·1 times that of the steam locomotive for there to be no increase in the fuel bill. Included in the pamphlet are tables of costs, curves of performance, sections devoted to the locomotive as a whole, the engine unit, and the various forms of transmission gear, while an appendix gives details of eight recent engines and a bibliography of articles on the subject published in the engineering Press. Like other publications of the Association, the pamphlet is obtainable from the Draughtsman Publishing Company, Ltd., 96 St. George's Square, S.W.

Utilisation of Waste Wood Chips.—At St. Helens, Oregon, an extensive plant has recently been put into operation by the Fir-Tex Insulation Board Co. for the conversion of the hitherto wasted Douglas fir chips from the lumber industry into board one inch thick for building and insulation work. An illustrated description of the plant by R. C. Smith appears in *The Valve World* for November 1930. The chips, of which the supply is almost unlimited, are first treated with steam, in 18 ft. spherical rotary digesters, and then are reduced to pulp by hammer shredders. From the storage chests the pulp is passed on to a Fourdriner machine having a wire screen 13 ft. wide and 100 ft. long with eight presses, each with two rolls, the main rolls weighing 12 tons each. The board, emerging from the machine at the rate of about 20 ft. per minute, is automatically cut into lengths and is then passed to a drier 360 ft. long with eight decks heated by oil-burning furnaces. The plant is capable of producing 150,000 sq. ft. of one-inch board every 24 hours, but plans are already under consideration for the extension of the plant to ten times this capacity. The board has not only been used for building and refrigeration work but also tests in the sound studios at Hollywood have shown it to possess remarkable acoustic and sound-deadening properties.

Cooling Electrical Machinery.—After forty years' experience in the design of electrical machinery, engineers have found that the heating factor is the one which nearly always limits the size of electrical apparatus. The temperature rise of machinery in the early days was very difficult to guess, but now that the conductivity of insulating materials and the laws of the loss of heat by air convection currents are known, approximate values for this rise are easily found. The maximum permissible temperature rise of any portion of a machine, the so-called hot spot temperature, is determined by the standard specification. Unfortunately, it is difficult to get international agreement on permissible temperature rises. They naturally depend on permissible overloads and these vary in different countries. In Britain, for example, the maximum permissible temperature rise for the commutators of very small motors is 45° C., in America 65° C., and in Germany 60° C. As the overload conditions are often different, it is difficult to compare the relative value of home and foreign machines. In a paper read to the Institution of Electrical Engineers on Nov. 6, Mr. Hoseason described various methods of heat dissipation and compared their relative values. The cooling medium most frequently used is air. Large generators and motors generally work with a ventilating air circulation system closed on itself with a water-cooler in the path of the air. In these cases the heat passes from the surfaces of the hot parts into the circulating air, is conveyed to the water in the cooler, and then carried by an outlet into a pond or river. Hydrogen is now not uncommonly used in place of air in the closed circuit, on account of its high thermal conductivity and the less power required to keep it circulating. In air-cooled machines it is found necessary to circulate about 100 cubic feet of air per minute per kilowatt lost, and in water-cooled machines about a gallon of water per minute for the same loss.

Biological Control of the Greenhouse White-Fly.

By E. R. SPEYER, Entomologist to the Experimental and Research Station, Cheshunt.

THE greenhouse white-fly is a pest of a number of plants grown under glass, and has, during the past fifteen years, become so widely distributed in Great Britain, Ireland, and the Channel Islands that the owner of the smallest conservatory must by this time be familiar with it and with the sordid appearance of his plants when infested by this insect.

Through the researches of Dr. Ll. Lloyd at the Cheshunt Experimental Station in 1920, it was shown that the pest could be controlled in commercial tomato and cucumber nurseries by fumigation either with the cheap 'cyanide' process or with the vapour of the more expensive liquid, tetrachlorethane. His demonstration of the correct methods of fumigating so as to reduce injury to the tomato plant to a minimum resulted in an incalculable saving to the industry.

In spite of the comparatively widespread use of these fumigants, the general white-fly population continued to increase in subsequent years, the commercial grower began to realise certain difficulties connected with extensive fumigation, and certain varieties of greenhouse plants were found to be very seriously injured by the vapour of tetrachlorethane.

The appearance of a parasite enemy of white-fly in Surrey was recorded by the late Prof. H. Maxwell-Lefroy, but the habit of this particular species, which still exists in England, does not admit of its exercising any material measure of control over the pest. An allied hymenopterous parasite, *Encarsia formosa*, was found by Mr. L. Hawkins at Elstree, Herts, in 1926, and scales of white-fly, parasitised by this insect, were received at the Cheshunt Experimental Station through the *Gardeners' Chronicle*. Observations upon the habits of the parasite established the facts that it reproduces itself parthenogenetically; is capable of distributing itself quickly by flight not only within an area covered by glass, but in midsummer for distances of several miles over land interspersed with greenhouses; and that a complete control of white-fly infestation is obtained by it when warm temperatures prevail.

Anything approaching extermination of the pest within a short period of time could not be expected, as the parasite is entirely dependent upon the young stages of white-fly for its existence, and cannot survive the winter either out-of-doors or in unheated greenhouses. However, the results of distribution during the summer of 1927 were so promising, that an application was made to the Empire Marketing Board, which generously gave a grant for the erection of a glasshouse in which the parasite could be propagated upon a larger scale.

During the earlier investigations upon the breeding habits of the parasite, an important fact came to light, namely, that the percentage parasitisation of white-fly scales is not the same upon all types of plant. The tobacco plant in particular, when grown in small pots, produces a sticky foliage upon which the white-fly breeds readily, but to which the parasite shows some aversion. It is due to this fortunate circumstance that a stock of white-fly can be maintained so that a continuous supply of parasitised scales upon other plants is obtainable.

The method of distribution is simple and has been adhered to as being the best with which to establish the parasite in greenhouses. Tomato plants are grown in pots or in the ground; tobacco pot-plants infested with white-fly and with a certain number of parasitised scales upon them are introduced amongst the former. The white-fly soon distribute themselves and lay eggs upon the lowest branches of the tomato plants; the scales which result from these eggs readily become parasitised and are recognisable by the jet-black colour which they assume 11-14 days after each has received a parasite egg. This blackening marks the time at which the pupal white-fly is destroyed by the larva of the parasite within the scale-case. When a large number of black scales have made their appearance, the low branches are removed, packed in boxes, and sent out to the grower, who ties them into small bunches and hangs them about in his infested house for a period of three weeks, during which time the parasite larva pupates and finally emerges, through a hole which it cuts in the roof of the scale-case, as the adult winged parasite, which immediately begins to deposit eggs in white-fly scales in its new environment.

In the meantime, more white-fly have bred upon the now lowest branches of the original tomato plants, which are afterwards used as another supply for distribution, and so on. A single series of tomato plants will thus yield a continuous supply of parasites for several months if transferred to 12-inch pots when young or when grown in the ground. At least a thousand parasitised scales may be present upon a single tomato branch, and each parasite eventually emerging is capable of causing the subsequent destruction of some fifty white-fly scales.

Male parasites appear rarely and usually only when temperatures have fallen below 60° F. over a period of some weeks. Under such conditions the fertility of the female may be much reduced. Adults of both sexes measure rather less than $\frac{1}{40}$ in. in length, so that they are not readily noticed unless very large numbers are present.

The approximate number of parasitised scales distributed in this way to growers of glasshouse plants during the past four years may be of interest:

Year.	Approx. No. Distributed.	Recipients.	Localities.
1927	15,000	13	5 English, 1 Welsh County.
1928	200,000	92	20 Counties, England and Wales.
	20,000	..	Royal Botanic Gardens, Kew.
	20,000	..	Canada.
	10,000	..	Channel Islands.
Total	250,000	..	
1929	900,000	509	40 English Counties.
	20,000	28	Wales.
	30,000	14	Scotland.
	20,000	11	Ireland.
	100,000	16	Channel Islands.
Total	1,070,000	578	
1930	1,350,000	745	42 English Counties.
	40,000	38	Wales.
	50,000	16	Scotland.
	10,000	6	Ireland.
	50,000	22	Channel Islands.
Total	1,500,000	827	

Up to May 1930, boxes of parasites were distributed to applicants free of charge, but afterwards a charge had to be made to defray the cost of packing, etc., except to members and associates of the Nursery and Market Gardens Industries Development Society, Ltd., which controls the Cheshunt Experimental

Station. After this system was adopted, the number of applications fell off, so that the supply of parasites available exceeded the demand.

In 1928 reports were received from the majority of the recipients as to the measure of control which the parasite had effected. Apart from a negligible number of cases in which the parasite failed to establish itself, about half reported complete and the rest partial control. Owing to the numbers supplied, it was impossible to obtain similar information in later years, but many reports of complete control have come to hand from all quarters.

The working of the parasite is best judged of from tomato-houses in the Lea Valley, in some parts of which the pest has been extremely severe for many years. In these particular areas, it has been found unnecessary to make use of fumigants during both the last and the current year.

The very large number of parasites which continually escape from the breeding house at Cheshunt appear to have furthered the distribution of the beneficial insect throughout glasshouses in Hertfordshire, and the white-fly population of that county, in which there is almost as great an area of glasshouses as in the whole of the rest of Great Britain, has definitely been reduced to a small fraction of what it was five years ago.

Applications for white-fly parasites should be made to the Experimental and Research Station, Cheshunt, Herts, not later in the year than September, nor earlier than March, unless minimum night temperatures of 55° F. can be maintained in the greenhouse during the winter months. Particulars of charges, etc., will be forwarded immediately to applicants.

It is useless to introduce the parasite into greenhouses in which the white-fly is not breeding at the time of receipt of parasite material. The parasite is quite harmless to vegetation and to animals, and does not parasitise insects other than the white-fly. In cases of severe infestation, when immediate control of white-fly is demanded, the greenhouse may be fumigated with a half dosage of 'cyanide' or tetrachlorethane without injury to the parasite, which is also not materially affected by other fumigants and sprays generally used for the control of pests upon living glasshouse plants, with the possible exception of paraffin emulsion.

An illustrated account of the white-fly and its parasite was published in the *Journal* of the Royal Horticultural Society, vol. 54, part 1, p. 181, January 1929, and a detailed account of the life-history of *Encarsia formosa* appeared in the *Bulletin of Entomological Research*, vol. 18, pt. 3, p. 301, March 1927.

Current Mortality Rates.

THE recent inaugural addresses by Mr. H. M. Trouncer at the Institute of Actuaries in London and by Mr. Steuart E. Macnaghten at the Faculty of Actuaries in Edinburgh, besides dealing with certain technical matters, discussed subjects of more general scientific interest, and directed attention to the great decrease in the rates of mortality between ages 20 years and 70 years in the general population, and presumably also among the lives assured by the various companies in Great Britain.

Mr. Trouncer mentioned that it is common knowledge to insurance offices that investigate their own experience, that, apart from yearly fluctuations, the rates of mortality are now lighter than ever before. The two actuarial societies have in hand a new continuous investigation into the mortality experience of assured lives and annuitants, and while results with regard to the latter have already been published, with forecasts of future mortality and extensive tables, the work on assured lives has taken longer to arrange and the results for the three years 1924–26 will only be fully available early next year, but will be quickly followed by a further three years' experience. This last point is important, as there might be a danger in using the figures of three such light mortality years as 1924–26.

Mr. Macnaghten referred also to research into the effect of family and personal history and occupation and foreign residence on mortality and sickness, and reminded his audience that, a few years before the War, Mr. Lewis P. Orr delivered a valuable address on this subject and advocated that a bureau of research should be set up. The idea was received favourably and we have reason to believe that a scheme was actually worked out in a preliminary way and put before the insurance offices. Then the War came and all such work had to be put aside. In spite of various post-War difficulties, much has already been done to bring mortality statistics up-to-date, and it remains for the future to show how far the work can be extended to special classes of risk, as has been possible in the United States, where the War interfered less.

It would seem that an investigation into the mortality of assured persons who proceed to tropical or sub-tropical areas is required, and there is no doubt that the information at present available is incomplete and untrustworthy, though individual actuaries have done something to fill the gap, as, for example, Mr. H. E. Raynes, for East and West Africa. The risk in all such cases has decreased: mainly owing to the great advances in tropical hygiene and preventive medicine, though a little of the apparent improvement may be attributed to a wiser choice of the men sent abroad.

Mr. Macnaghten amused his audience by an example of the change in point of view. "It is difficult", he said, "to realise to-day that eighty years ago lives resident in the United States west of the Mississippi were not accepted for life assurance except on almost prohibitive terms." With a further improvement in conditions, with greater knowledge of how to live in unhealthy areas, and with accurate statistics to measure the risk, it is to be hoped that those who look back in future years will notice similar changes.

The British Industries Fair.

THE Committee which was appointed by the President of the Board of Trade in February 1930, under Lord Chelmsford as chairman, to examine the present situation of the British Industries Fair and to consider means of increasing its utility to British trade, in its report (London: H.M.S.O. Cmd. 3726. Price 6*d*. net) makes the basic recommendation that "the Fair should be developed so as to become a truly national manifestation of the quality and range of British products and an increasingly powerful factor in the expansion of our trade". Both Government and manufacturers generally should accord it more vigorous support, and the public should be encouraged to learn through the Fair that British

manufacturers can supply their needs. A policy of 'Sell British Goods' is at least as important as 'Buy British Goods', if for no other reason than the difficulties at present encountered by customers wishing to purchase British goods—difficulties which, in some cases at any rate, are due to the obvious reluctance or indifference of the retailer to sell British goods.

The British Industries Fair is the direct outcome of the measures taken by the Commercial Intelligence Branch of the Board of Trade, immediately after the outbreak of War in 1914, to deal with the situation which had arisen in many industries owing to the cessation of trade with enemy countries. From the first Fair, which was held in May 1915, in the Royal Agricultural Hall, London, with an exhibitors' floor space of 80,000 square feet, the size of the Fair has steadily developed; the Birmingham Section was started in 1920, and in the 1929 London Fair the area occupied by exhibits was more than 310,000 square feet. Since 1926 the Treasury has made a grant of £25,000 per annum for advertising purposes, but the Committee reports that it received overwhelming evidence that this sum was totally inadequate for effective world publicity, and recommends that the Government should establish a regular annual publicity grant of a minimum of £100,000 and recognise the Fair as an integral feature of British economic policy. The Committee agrees with the view that advertisement of the Fair abroad is of value to British industry generally, and records its conviction that expenditure of this character, by assisting the restoration of prosperity to British industry, will prove to be a national economy and be amply justified by results. The preponderance of evidence was emphatically against increasing charges for space as a contribution towards advertising expenses; and regarding the Fair as a means of expanding British industry, the Committee urges that the recommended national contribution is insignificant compared to the present expenditure on unproductive relief of unemployment which it is designed to reduce.

Other recommendations include the acquisition of a site easily accessible from central London, and its equipment with buildings capable of extension as required; the continuance and, if possible, supplementing of the Government banquet to celebrate the opening of the Fair; the establishing of a special Committee to direct the expenditure of the publicity grant, the administration of which and the management of the London Section should remain under the control of the Department of Overseas Trade; some extension of the hours of admission of the public to the London Section, stricter exclusion of the general public during the hours reserved for trade buyers, and an extension of the free passport *visa* granted to foreign buyers attending the Fair to cover at least three months and return visits to Great Britain during that time.

Lattice Distortion and the Hardening of Metals.

IT has hitherto been regarded almost as axiomatic that lattice distortion of a metal will result in hardening. Doubt of the universality of such a hypothesis is now justified, however, as the result of work done by W. L. Fink and K. R. van Horn, which formed the subject of a paper read on Sept. 10 before the Institute of Metals at its annual autumn meeting at Southampton.

The experiments recorded consisted in elastically deforming samples of 70 : 30 brass and duralumin by bending and, whilst still under stress, in measuring the hardness by the Rockwell apparatus on scale 'E'. X-ray examination was made simultaneously, and the effacement of the $K\alpha$ doublet, the diffuseness or elongation of the reflection images, and the widening of the diffraction rings, proved that lattice distortion had in fact been produced.

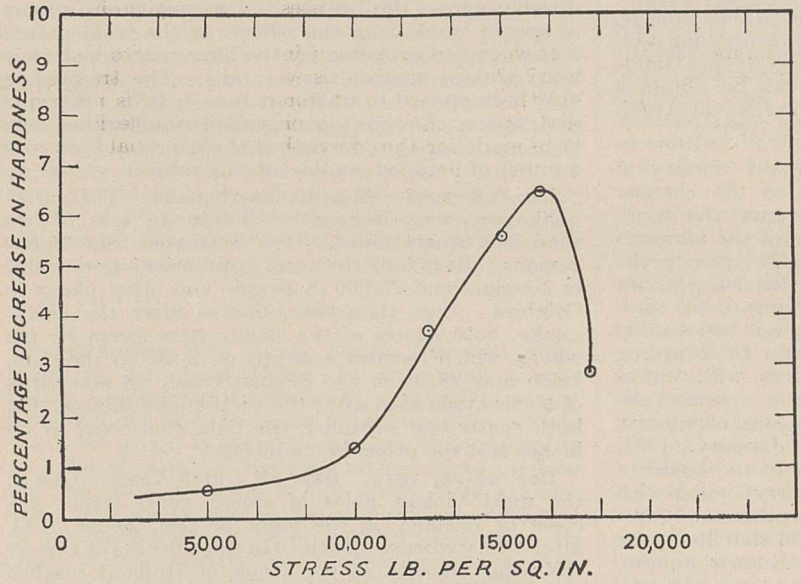

FIG. 1.—Relation between hardness and stress in duralumin. Reproduced by courtesy of the Institute of Metals.

In Fig. 1 the changes in hardness for the duralumin specimen are shown in relation to the stress set up. The material is at first softened and not hardened, the softening increasing with the stress up to the elastic limit. At stresses higher than this, the hardening resulting from the plastic deformation counteracts the softening effect and hardening commences. An exactly similar result was given by the work on the brass, which softened even more than did the aluminium alloy.

It is clear, then, that lattice distortion resulting from elastic deformation can be accompanied by an appreciable decrease in hardness. As the authors point out, however, it is conceivable that where lattice distortion is of a very local character, it may have the opposite effect and harden the material.

In corroboration of the results which have been obtained, the authors cite measurements made by Gayler and Preston on the aluminium alloy with 4·5 per cent of copper and by Chartkoff and Sykes on iron alloyed with 25 per cent of tungsten. In the former case, a specimen quenched from 500° C. and then aged first at room temperature and then for 3 hours at 200° C., which showed maximum lattice distortion, had a Brinell hardness number of 57.

The same specimen after an additional 21 hours at 200° C. had reached a maximum hardness of 78 but with considerably reduced distortion. The iron-tungsten alloy, which had been quenched from 1520° C., had a Rockwell 'C' hardness of 14 and pronounced lattice distortion. This alloy after a subsequent ageing for 40 hours at 800° C. was relatively free from strain but the hardness had risen to 39.

It would appear, then, that lattice distortion resulting from the precipitation of a new phase will, in some cases at least, reach a maximum and then partially disappear before the stage of greatest mechanical hardness has been attained. F. C. T.

University and Educational Intelligence.

THE eighteenth election to Beit Fellowships for Scientific Research, which are of the annual value of £250 and tenable at the Imperial College of Science and Technology, will take place on or about July 14 next. Not more than three fellowships will be awarded. Candidates must be less than twenty-five years of age at the time of election. Applications must be received by April 14. Particulars can be obtained, by letter only, from the Rector, Imperial College, South Kensington, London, S.W.

THE following scholarships will be offered for competition by the Institution of Naval Architects in 1931: *Naval Architecture*—Elgar Scholarship (£130 per ann. for 3 years) and the Vickers-Armstrong Scholarship (£150 per ann. for 3 years). *Marine Engineering*—Parsons Scholarship (£150 per ann. for 3 years) and the Denny Scholarship (£75 per ann. for 4 years). The Denny Scholarship is open to boys less than nineteen years of age who have not yet begun their apprenticeship, and is tenable at the University of Glasgow. The remaining scholarships are open to apprentices between the ages of eighteen and twenty-three, and are tenable at the Royal Naval College, Greenwich; University of Glasgow; Armstrong College; University of Liverpool; and the City and Guilds (Engineering) College. Particulars can be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE Meldola Medal (the gift of the Society of Maccabæans) is awarded annually to the chemist whose published chemical work shows the most promise and is brought to the notice of the administrators during the year ending Dec. 31 prior to the award. The recipient must be a British subject, not more than thirty years of age at the time of the completion of the work. The medal may not be awarded more than once to the same person. In awarding the medal for 1930 the adjudicators will, unless exceptional circumstances arise, give special consideration to work in inorganic or physical chemistry. The next award will be made in January, 1931. The medal is awarded on the advice of the board of examiners of the Institute of Chemistry sitting with representatives of the Society of Maccabæans. Communications should be addressed to the Registrar of the Institute of Chemistry, 30 Russell Square, London, W.C.1.

THE Commonwealth Fund of New York City, supported by gifts from the late Mrs. Stephen V. Harkness, has established for British graduate students a number of fellowships tenable at American universities. The fellowships are normally tenable for two years and are of the annual value of about £600. Thirty fellowships are available to graduates, either men or women, who are unmarried and not more than thirty years of age on Sept. 1; and ten are available to colonial graduates who have studied at a university in the British Isles and to graduates holding an appointment overseas under the British Government, the Government of India, or the Government of a British Dominion, Colony, Protectorate, or Mandated Territory. Candidates are required to produce evidence of proficiency in some recognised branch of university learning, and must also submit a definite scheme of research or study proposed to be carried out during their residence in the university to which they may be assigned. Applications must be forwarded through the authorities of the candidate's college or university and must reach the Secretary to the Committee, Mr. R. H. Simpson, 35 Portman Square, London, W.1, by Feb. 9, 1931, at latest. In 1930 the number of entries for ordinary and Dominion fellowships was 128 (104 men and 24 women); 35 candidates entered for the Service fellowships and three were appointed. Of the 32 fellows appointed, 20 came from the Faculty of Science and 12 belonged to the group of arts subjects.

Historic Natural Events.

Dec. 28, 1879. The Tay Bridge Storm.—On the evening and night of Dec. 28 a deep barometric depression passed along the north-west and north coasts of Scotland, moving north-eastwards. Violent gales from west and south-west were experienced over Scotland, the velocity reaching 88 miles per hour at Glasgow from 7.15 to 7.18 P.M. The storm is memorable for the destruction of the Tay Bridge at Dundee. The central raised portion of the bridge, 1050 yards long, broke away and at 7.30 P.M. a train and 75 persons, not one of whom was saved, plunged into the river. It seems probable that the bridge actually fell while the train was crossing. The wind at the time was blowing from west-south-west, almost directly across the bridge, and a continuous stream of sparks came from the wheels as the train passed across, caused probably by the force with which they were pressed against the lee rails. The bridge had only been opened to traffic on June 1, 1878; its rapid destruction showed that insufficient allowance had been made for the pressure of the wind, and led to a number of detailed studies on this subject.

Dec. 28, 1908. Messina Earthquake.—The earthquake was very destructive within an area of less than 200 square miles. It is estimated that 75,000 persons (about half the total population) were killed in Messina, and 25,000 in Reggio and other places in Calabria. Less than ten minutes after the earthquake, both shores of the straits were swept by sea waves, which reached a height of 35 ft. on the Calabrian and 28 ft. on the Sicilian coast. A new series of levels made soon after the earthquake showed that both coasts had subsided, the Calabrian coast by 24 inches and the other by 28 inches.

Dec. 28-29, 1914. Gale off Dutch Coast.—One of the most violent gales of recent years struck the coast of Holland on the night of Dec. 28–29, 1914, after a very stormy month. On the morning of Dec. 29 the wind velocity at the Hook of Holland reached 94 miles per hour, and great damage was done to shipping. The gale was notable also for its long duration and great extent.

Dec. 30, 1788. Severe Cold in France.—It is recorded in the register of the Canton of La Châtre, Department of l'Indre, that "the frosts have been so severe this year in the month of December that the barometers (*sic*) have fallen two degrees lower than in 1709, especially Dec. 30. The snows covered the ground for more than six weeks."

Societies and Academies.

LONDON.

Linnean Society, Dec. 4.—J. McLuckie: On a natural *Grevillea* hybrid. Its hybrid character was first suggested by Fletcher and Musson (Linn. Soc. N.S.W., 1927) on facts of distribution and morphology. A comparative analysis of the hybrid and its putative parents is given. Two distinct types of *G. Gaudichaudii* occur in Nature, and their graphs reveal their differences. It has been synthesised artificially, and hybrid seedlings of the F_1 generation obtained. The experimental work reveals the comparative sterility of all three 'species'. The facts of distribution of *G. Gaudichaudii*, the results of a detailed analysis of its main morphological characters and of synthetic experiments in progress, seem to indicate that it is a natural hybrid between *G. laurifolia* and *G. acanthifolia*.—B. Storrow: Some fluctuations in zoological populations during the nineteenth century. The periods of major change are well marked, and the region affected is from the coast of Portugal to Spitsbergen. An amelioration of winter climate was due to a northerly extension of warm water which influenced the Arctic; the changed Labrador Current affected the fishes of the American coast from Newfoundland to Cape Cod. Local and widespread change, 1870–80, coincided with an increased contribution to the North Atlantic from the South Equatorial Current. The axis of the Gulf Stream approached nearer to the American coast, and the southward effect of the Labrador Current decreased. Such a change increases the intermediate area of the North Atlantic. Variations in circulation and the incidence of fisheries become possible.

DUBLIN.

Royal Irish Academy, Nov. 10.—E. J. Conway: A statistical analysis of the law governing the urea excretion in man. The validity of an equation expressing the excretion of urea in the human subject has been demonstrated by statistical methods. This equation is similar in form to a diffusion equation and is in fact only a special case of a general equation expressing either diffusion or secretion. The K of the equation is independent of the variables urine volume, blood concentration, and body weight. The influence of other unknown variables on K manifests itself in a peculiar frequency distribution.

EDINBURGH.

Royal Society, Dec. 1.—G. Bond: The stem endodermis in the genus *Piper*. In one group a continuous endodermis is present, in a second the layer is present but is in a discontinuous condition, while in a third group it is quite absent. This and other examples of variation in closely related types suggests that the stem endodermis can have little importance. The endodermis in *Piper* is also characterised by its persistence in the primary condition, its power of accommodation to the increasing bulk of the vascular cylinder, and by the irregular deposition of Casparian strips. In *Piper*, and possibly elsewhere, the Casperian strip is probably secreted by the endodermal protoplast.—Alastair Graham: On the morphology, feeding mechanisms, and digestion of *Ensis siliqua* Schumacher. There may be three or four apertures in the mantle—two posterior siphons and an anterior pedal aperture are of constant occurrence, but there may be a fourth aperture about the middle of the ventral surface. The foot contains six definite series of muscles and in the young animal a well-developed byssus gland of which no trace remains in the adult. The muscles and nervous system (remarkable for the large number of peripheral anastomoses) are described in detail. A comparison of the ciliary mechanisms of *Ensis* with those of other lamellibranchs, for example, *Ostrea*—an animal with widely different habits—leads to the conclusion that throughout the class (except the septibranchs) these mechanisms will be found to be very similar. The style contains a strong amylase and also an oxidase; the digestive diverticula contain a protease, a lipase, a diastase, and a glycogenase.—L. Mirskaia and F. A. E. Crew: On the pregnancy rate in the lactating mouse, and the effect of suckling on the duration of pregnancy. Among primiparæ the pregnancy rate during lactation was found to be 24 per cent, among multiparæ 50 per cent, the difference being possibly a reflection of a difference in degree of somatic maturity. In all the cases of pregnancy during lactation the duration of gestation was prolonged. The figures do not confirm Daniel's law. Prolongation is due to an insufficiency of the hormone(s) responsible for the inception and maintenance of pregnancy.—B. P. Wiesner: Further observations on the mechanism of the diphasic sex cycle. Œstrogenic extracts from the anterior lobe and the gonadotropic substance of pregnancy urine interrupt pregnancy in mice in certain concentrations, but do not interfere with its progress in high concentration. The experiments are interpreted as supporting Wiesner and Crew's theory of the existence of two gonadotropic hormones. No gonadotropic hormones were found in placentæ of diphasic animals. The second phase of anterior lobe secretion in the mouse persists at least up to the twelfth day of pregnancy.

CAPE TOWN.

Royal Society of South Africa. Sept. 24.—E. Newbery: The theory of electrolytic valve action. An insulating anodic film is built up, which is impermeable to the large anions usually present but permeable to hydrogen ions. As the films are very thin and the hydrogen ions very rapid, there is no difficulty in accounting for the observed rapid changes of potential and all the known phenomena of electrolytic valve action.—B. F. J. Schonland: Thunderstorms and the penetrating radiation (2). Thunderclouds which seem to have an excess positive charge elevated above a negative charge produce much larger reductions in the intensity of the penetrating radiation than the more usual type. This can be readily interpreted if the primary radiation consists either of positively charged particles or of ultra-gamma quanta, but it does not support the view that the radiation is made up of fast beta rays.—C. van Riet Lowe: Giant crescents. The term 'giant crescent' is used to describe an artefact that characterises a hitherto unnoted and unrecorded culture in the Stone Age of South Africa. Since the discovery of an isolated specimen by Stapleton at the Kasouga River mouth more than five years ago, a number of others have been found associated with a well-defined industry that was practised from Mazeppa to Algoa Bay along the south coast and so far inland as the Orange River—an area that covers about 20,000 square miles. Technically and typologically the culture represents a transition from the Middle to the Later Stone Age and probably formed an integral part of a blending or contact between palæanthropic and neanthropic folk, the main influence being neanthropic. It shows remarkable affinities with the Late Mousterian and Early Aurignacian industries of Europe.—A. C. Leeman: Holism.

CRACOW.

Polish Academy of Science and Letters, July 7.—St. Ziemecki: An apparatus for the study of the Raman spectra of organic compounds. The apparatus proposed by Raman has been modified so as to permit the use of so little as 20 c.c. of liquid under examination. The experimental tube is placed in a bath of paraffin oil, which has the effect of reducing the reflections on the walls. The author considers that the study of the Raman spectrum of a substance will probably be regularly employed in organic laboratories.—L. Marchlewski and Mlle. B. Charlampowiczówna: The absorption of ultra-violet rays by certain organic substances.—Mlle. A. Kozlowska: The genetic elements of the steppe flora in Poland.—L. Ejsmont: *Astiotrema emydis*, a trematode of *Emys orbicularis*.—E. Godlewski, jun.: New researches on the phenomena of agglutination of the spermatozoids by sperm and by substances drawn from the organism of other species.—S. Skowron and Mme. H. Skowron: The action of tripaflavine on the karyokinetic division of the cell.—T. Pawlas and S. Skowron: The action of colouring matters derived from acridine on the male sexual cells and their production.—Mme. Z. Kolodziejska and Mlle. W. Halber: The chemical nature of the cancerous antigen.—Wl. Florkowski: The lymphatic vessels of the head of the eel (*Anguilla anguilla*).—A. Dunajewski: The lymphatic vessels of the body of the eel (*Anguilla anguilla*).—P. Socha: The development of the blood vessels in the brain of the frog.—T. Marchlewski and Br. Slizynski: The influence of prolonged selection on the development of a vestigial organ. An account of an attempt to increase the average length of the wings in the winged varieties of *Drosophila ampelophila*.—T. Marchlewski: The craniology of the domestic dog.—T. Marchlewski: Certain factors determining the hereditary transmission of an abundant milk production in cows.—J. Borowik: The migration of *Pleuronectes limanda* in the central part of the Baltic.—J. Borowik: Marking *Pleuronectes* in the bay of Dantzig.

ROME.

Royal National Academy of the Lincei, May 30.—U. Cisotti: Isotropic tensors and hemi-isotropic tensors.—G. Abetti: Altitude of the chromosphere in 1929 and the course of the present solar cycle. Observations at Arcetri and Madrid in 1929 show that the total area of the solar protuberances (measured in units of protuberance), which fell by 53 from 1927 to 1928, diminished by 156 from 1928 to 1929. Thus the maximum of the present solar cycle has passed.—A. Angeli: Constitution and reactions of isomeric diazohydrates. An answer is given to Hantzsch's objections to the author's results and to the conclusion that stereoisomerism alone explains all differences in behaviour between normal diazohydrates and their isomerides.—G. Bruni and G. Natta: The crystal structure of thiophen. X-ray investigation of the crystal structure of thiophen by the powder method, with the aid of a special spectrograph adapted for use at low temperatures, shows that the crystal has a tetragonal cell with the axial ratio $a:c=1:1{\cdot}32$. The lattice constants at $-170°$ are: $a=7{\cdot}225$, $c=9{\cdot}54\pm0{\cdot}01$ A., $v=498\times10^{-24}$ c.c. The unit cell contains four molecules C_4H_4S, and the density is 1·11. Use was made in the measurements of a metallic calcium anti-cathode, application of which is particularly advantageous in the examination of organic substances.—S. Franchi: Uniformity in character of the *Helmynthoida labyrinthica* zone from Ubaye to the Alps and to the Ligurian coast, and consequently its great chronological value.—G. Levi and G. C. Dogliotti: Structure and properties of the striated and reticular fibrils in certain living tissues. The actual existence of these fibrils is demonstrated in a number of living organs, namely, the spleen, lymphatic glands, thymus, marrow, liver, kidneys. Study of the resistance to tension of the fibrils in the spleen and liver by means of Péterfi's micro-manipulator shows that the fibrils are elastic in the ordinary sense of the term.—G. Andreoli: Limits and pseudo-limits of a succession.—Giuseppina della Moglie: Study and tabulation of a particular function.—Miron Nicolesco: Theorems of the mean for functions of two real variables.—Enrico Volterra: Determination of the tensions in an elastic medium due to a small displacement of an immersed rigid sphere.—F. Lamberti: Investigations on the baricentric, scalar, and vectorial moments of the quantities of motion for a material system.—D. Bonvicini: Certain fundamental theorems of electrodynamics and of the statics of elastic solids.—E. Fermi: Interpretation of the principle of causality in quantistic mechanics. An attempt is made to define up to what point causality may, according to quantistic mechanics, be spoken of, and in what sense the statement that quantistic mechanics does not lead to a determination of future events, is to be understood. The case discussed is that of a point movable along a straight line, but the considerations advanced may be readily extended to more complicated systems.—E. Persico: The relation $E=h\nu$ in wave mechanics.—Washington del Regno: The laws of emission of nickel. The few results yet published on the radiation of nickel indicate that the total emission of this metal may be expressed by a relation of the Stefan-Boltzmann type, $E=KT^n$, but somewhat divergent values have been obtained for n by different investigators. By means of an experimental arrangement simpler and more certain in the determination of the temperature of the emitting lamina than those previously used, the value 4·586 is obtained for n over the extended temperature interval 360°-60°.—G. Wataghin: Seizure of electrons by ions. Application of the methods of wave mechanics is capable of furnishing an interpretation of the recent experimental results of Davis and Barnes on the seizure of electrons by α-particles.—V. Ronchi: Shadow fringes in the study of very small spherical aberrations. Investigation of simple spherical aberration by means of shadow fringes shows that the deformations to which these fringes are subject are appreciable even when the images no longer reveal the presence of spherical aberration.—G. R. Levi and D. Ghiron: Oxidation of chlorites to chlorates by means of permanganates. This oxidation takes place quantitatively in cold, neutral solution and is rendered more rapid by the presence of salts of calcium, zinc, etc., which neutralise the alkalinity of the process:

$$3ClO_2^- + 2MnO_4^- + 2H_2O \rightarrow 3ClO_3^- + 2MnO_2 + 2OH^-.$$

The course of the reaction is not disturbed by excess of the permanganate.—G. Natta and A. Nasini: Structure of inert gases (1). Investigation of xenon. At about 100° absolute, the side of the unit cell of xenon has the value $a=6{\cdot}18\pm0{\cdot}02$ A., the volume being 236×10^{-24} c.c., and the density, assuming that the cell contains four atoms and taking $1{\cdot}65\times10^{-24}$ gram as the weight of the hydrogen atom, 3·64. This value for the density corresponds with the experimental value for liquid xenon at its boiling point, namely, 3·06. On the assumption of the tangency of spherical atoms in the lattice, the apparent radius of the xenon atom is 2·18 A.—A. Ostrogovich and V. Galea: Investigations on γ-triazines. Syntheses of ethyl- and propyl-aminothioltriazines, and new data on methylaminothioltriazine. The conditions for obtaining the higher homologues of methylaminothiol-

triazine and aryl and arylalkyl derivatives of aminothioltriazine are given. The ethyl compound melts at 257°-258° and the propyl compound at 262°-263°.—A. Desio: The presence of the fossiliferous Silurian in the island of Coo (Ægean Sea).—Romolo de Fazi: Action of ultra-violet rays on the germination of barley for malting. The effects of the action of ultra-violet rays on germinating barley include acceleration of the germinating process, prevention of mould growth, and increase in the vitamin content. This treatment is found to be applicable, with beneficial results, to the manufacture of malt under industrial conditions.—C. Guareschi: First experimental results on the development of the otocysts of urodele amphibia. By means of a new experimental procedure, it is shown for the first time that the otocysts of urodele amphibia form a mosaic system.

SYDNEY.

Linnean Society of New South Wales, Sept. 24.—J. R. Malloch: Notes on Australian Diptera (26). The group treated in previous papers in this series as subfamily Ochthiphilinæ is now regarded as of family rank. Keys are given to the genera.—A. M. Lea: Descriptions of new species of Australian Coleoptera (21). Eleven new species of Scarabæidæ and thirteen new species and five new genera of Curculionidæ, mostly from Australia, and three species from Fiji and two from Papua closely allied to Australian forms, are also described.—J. Calvert: An abnormal *Xanthium* burr. A burr in which two male florets occupy portion of the burr, whilst just alongside, a loculus contained what looked like an unopened floret. This made up one half of the burr, the other half consisting of the normal one-seeded loculus.—W. W. Froggatt: Notes on gall-making coccids, with descriptions of new species (2). Five species of *Apiomorpha* are described as new. In some cases the specific names of the Eucalypts on which the galls develop, which were previously unknown, are recorded.—C. Deane: Trichopterygidæ of Australia and Tasmania: descriptions of new genera and species. Hitherto only six species of Trichopterygidæ had been described from Australia. The present paper adds eleven new species, classed in eight genera, six of which are new, most of them being very distinct. One new genus is blind, there being no eyes or eye sockets, nor any suggestion of a place for the eyes. *Rodwayia* is also blind, but differs in most other ways.

Official Publications Received.

BRITISH.

Livingstone College. Annual Report and Statement of Accounts for the Year 1929-30. Pp. 24. (London: Leyton, E.10.)

Transactions of the Optical Society. Vol. 31, 1929-30, No. 4. Pp. 169-240+vi. (London.) 10*s*.

Medical Research Council. Special Report Series, No. 150: Medical Uses of Radium; Summary of Reports from Research Centres for 1929. Pp. 32. (London: H.M. Stationery Office.) 9*d*. net.

Colony and Protectorate of Kenya. Forest Department Annual Report 1929. Pp. 28. (Nairobi: Government Printer.) 1*s*.

Mysore Geological Department. Records, Vol. 27, 1928. Pp. iii+34. 2 rupees. Records, Vol. 28, 1929. Pp. iii+39. 2 rupees. (Bangalore: Government Press.)

Journal of the Chemical Society. November. Pp. iv+2401-2582+x. (London.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 3, Session 1929-30. Pp. xvii-xxiv+187-255. (Edinburgh.) 7*s*. 6*d*.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, November. Pp. 741-837+xlii. (London.)

Ministry of Health. Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122D/T.) Pp. 21. (London: Ministry of Health.)

British Industries Fair. Report of the Committee appointed by the Board of Trade, under the Chairmanship of Viscount Chelmsford, to examine the present Situation as regards the British Industries Fair and to consider what Means can be adopted to increase still further its Utility to British Trade. (Cmd. 3726.) Pp. 30. (London: H.M. Stationery Office.) 6*d*. net.

Year Book of the Royal Society of Tropical Medicine and Hygiene, Session 1930-31. Pp. 41+xcviii. (London.) 5*s*. net.

London School of Hygiene and Tropical Medicine. Report on the Work of the School for the Year ended July 31st, 1930. Pp. 34. (London.)

Ministry of Health. Treatment of Tuberculosis: Analysis of Work done during the Year 1929 under the Schemes of Local Authorities for the Treatment of Tuberculosis, as shown in the Returns furnished in accordance with Memorandum 37/T. (Memo. 131c/T.) Pp. 9. (London: Ministry of Health.)

International Federation of University Women. Bulletin No. 12: Report of the Fifteenth Council Meeting, Prague, July 1930. Pp. 111. (London.)

Proceedings of the Liverpool Geological Society. Session the Seventy-first, 1929-1930. Edited by C. B. Travis. Part 3, Vol. 15. Pp. xv+179-266. (Liverpool.) 5*s*.

Souvenir, Cinchona Tercentenary Celebration and Exhibition at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1. Pp. 115. (London: The Wellcome Foundation, Ltd.)

Borough of Buxton. Museum Guide. Pp. 20. (Buxton.) 6*d*.

Proceedings of the Royal Society. Series A, Vol. 130, No. A812, December 2. Pp. 238. (London: Harrison and Sons, Ltd.) 12*s*.

FOREIGN.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 11, Novembre. Pp. 653-698. (Prague: Regia Societas Scientiarum Bohemica.)

U.S. Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 115: Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1930. Pp. ii+53. 10 cents. Research Paper No. 223: Apparatus for the Determination aboard Ship of the Salinity of Sea Water by the Electrical Conductivity Method. By Frank Wenner, Edward H. Smith, Floyd M. Soule. Pp. 711-732. 10 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 77, Art. 13: Some peculiar Spiral Fossil Forms from California and Mexico. By Wendell C. Mansfield. (No. 2836.) Pp. 3+2 plates. Vol. 77, Art. 14: New Forms of Sphecoid Wasps of the Genus *Didineis* Wesmael. By J. R. Malloch and S. A. Rohwer. (No. 2837.) Pp. 7. Vol. 77, Art. 51: Birds collected in Inner Mongolia, Kansu and Chihli by the National Geographic Society's Central-China Expedition under the direction of F. R. Wulsin. By J. H. Riley. (No. 2838.) Pp. 39. Vol. 78, Art. 3: A new Species of Trematode Worm of the Genus *Ornithobilharzia* from a Canadian Goose. By Rudolf Wetzel. (No. 2846.) Pp. 4+1 plate. Vol. 78, Art. 8: Fossil Decapod Crustaceans from Mexico. By Mary J. Rathbun. (No. 2851.) Pp. 10+6 plates. Vol. 78, Art. 11: Restudy of some Burgess Shale Fossils. By George Evelyn Hutchinson. (No. 2854.) Pp. 24+1 plate. Vol. 78, Art. 12: Notes on the Types of American Two-winged Flies of the Genus *Sarcophaga* and a few related Forms described by the Early Authors. By J. M. Aldrich. (No. 2855.) Pp. 39+3 plates. Vol. 78, Art. 13: Exploration of Ruins in the White Mountain Apache Indian Reservation, Arizona. By Walter Hough. (No. 2856.) Pp. 21+10 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 12: The Five Monacan Towns in Virginia, 1607. By David I. Bushnell, Jr. (Publication 3070.) Pp. 38+14 plates. (Washington, D.C.: Smithsonian Institution.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 8: Yokuts-Mono Chiefs and Shamans. By A. H. Gayton. Pp. 361-420. 80 cents. Vol. 29, No. 1: Archaeology of the Dalles-Deschutes Region. By W. Duncan Strong, W. Egbert Schenck and Julian H. Steward. Pp. vii+154+28 plates. 2 dollars. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

University of Illinois: Engineering Experiment Station. Bulletin No. 211: The Torsional Effect of Transverse Bending Loads on Channel Beams. By Prof. Fred B. Seely, Prof. William J. Putnam, William L. Schwalbe. Pp. 66. 35 cents. Bulletin No. 212: Stresses due to the Pressure of one Elastic Solid upon Another, with Special Reference to Railroad Rails. A Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Utilities Research Commission. By Prof. Howard R. Thomas and Victor A. Hoersch. Pp. 56. 30 cents. (Urbana, Ill.)

Sveriges Geologiska Undersökning. Ser. Ca, No. 22: Gällivare malmfält geologisk beskrivning. Av Per Geijer. With a Summary: Geology of the Gällivare Iron Ore Field. Pp. 115+4 tavlor. 10 kr. Ser. Ca, No. 23: Långbans malmtrakt geologisk beskrivning. Av Nils H. Magnusson. Summary: The Iron and Manganese Ores of the Långban District. Pp. 111+5 tavlor. 8 kr. (Stockholm.)

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse. Nr. 11: Ekspedisjonen til Østgrønland med *Veslekari* sommeren 1929. Av Anders K. Orvin. Pp. 85-146. Skrifter om Svalbard og Ishavet. Nr. 31: Verbreitung und Ausbildung des Mesozoikums in Spitzbergen, nebst einer Revision der Stratigraphie des Jura und der Unterkreide in Nowaja Semlja und einem Entwurf der mesozoischen Entwicklungsgeschichte des Barentsseeschelfes. Von Hans Frebold. Pp. 126+33 Tafeln. 17.00 kr. Nr. 32: Über Epidemien von unspezifischen Katarrhen der Luftwege auf Svalbard. Av Otto Abs. Pp. 27. 2.00 kr. Nr. 33: Ctenaspis, a new Genus of Cyathaspidian Fishes; a Preliminary Report. By Johan Kiær. Pp. 7. 1.00 kr. Nr. 34: Die Gattung Cerastium in der Flora von Spitzbergen. Von A. Tolmatchew. Pp. 8+1 Tafel. 1.00 kr. (Oslo: Jacob Dybwad.)

CATALOGUES, ETC.

Thermometric Lag. Pp. 16. (London: Negretti and Zambra.)

Pituitary (Posterior Lobe) Extract B.D.H. Pp. 4. 'Caprokol' Brand of Hexylresorcinal in Olive Oil. Pp. 4. (London: The British Drug Houses, Ltd.)

A Collection of Modern Books in all Classes of Literature. (No. 441.) Pp. 32. (London: Bernard Quaritch, Ltd.)

Bibliographie des Livres français sur l'Industrie et la Technologie publiée par les Maisons J.-B. Baillière et fils, Armand Colin, Ch. Béranger, Delagrave, Desforges-Girardot et Cie, Gaston Doin et Cie, Dunod, Gauthier-Villars et Cie, Léon Eyrolles, Edgar Malfère, Masson et Cie, Albin Michel, Société d'Éditions Géographiques Maritimes et Coloniales, l'Usine, 1919–1930. Pp. lxiv+234. (Paris: J.-B. Baillière et fils.)

Modern X-Ray Engineering: a Supplement to the General Catalogue. Pp. 30. (London: X-Rays, Ltd.)

Calendar for 1931. (London: British Museum (Natural History).)

Calendar for 1931. (Liverpool: The Liverpool Electric Cable Co., Ltd.)

Illustrated Books, 15th Century to Present Day. (Catalogue 533.) Pp. 72. (London: Francis Edwards, Ltd.)

Nickel Cast Iron: its Development and Present Position in Engineering Practice. (Nickel B7.) Pp. 28. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

TUESDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (1): Some Properties of Electrified Bodies (Juvenile Lectures).

WEDNESDAY, DECEMBER 31.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College, Victoria Embankment), at 5.

THURSDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (2): The Spark as a Current of Electricity (Juvenile Lectures).

FRIDAY, JANUARY 2.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—S. J. Davies: An Experimental Investigation into Induction Conditions, Distribution, and Turbulence in Petrol-Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. Fawssett and G. E. Moore: Apparatus and Methods for Accurate Maintenance of Large A.C. Energy Meters.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—Discussion on Portfolio Prints.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Benton: Weighing Machinery.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. F. Smithson: The Triassic Sandstones of Yorkshire and Durham.—E. St. John Burton: Periodic Changes in Position of the Run, near Mudeford, Christchurch, Hants.

SATURDAY, JANUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. M. Tyndall: The Electric Spark (3): Air as a Conductor of Electricity (Juvenile Lectures).

CONFERENCES.

DECEMBER 31 TO JANUARY 5.

GEOGRAPHICAL ASSOCIATION.

Wednesday, Dec. 31 (at Imperial Institute), at 5.30.—Suez Canal Film to be shown by Sir J. T. Davies.

Thursday, Jan. 1 (at London School of Economics).

At 11.30 A.M.—School Journeys Exhibition and Discussion.

At 2.—B. B. Dickinson: Presidential Address.

At 3.45.—Exhibition of Maps showing Agricultural Distributions in Scotland, prepared by H. J. Wood.

At 5.30.—A Regional Study of the Chod Villages of S.W. Bohemia—a Field Study by a Leplay House Group, with an Exhibit of Original Maps and Files of this and other Regions.

Friday, Jan. 2 (at London School of Economics).

At 10 A.M.—Major R. W. G. Hingston: In the Tree-Roof of the Guiana Forest (Lecture).

At 11.30 A.M.—Miss R. M. Fleming: Regions of Russia (Lecture).

At 2.30.—Meeting for Teachers in Secondary Schools for Discussion on a paper by B. C. Wallis on School Geography from the Point of View of an Examiner.

Meeting for Teachers in Primary Schools:—Geography and the Extension of the School Age. Discussion to be opened by E. J. Orford.

Saturday, Jan. 3 (at London School of Economics).

At 10.15 A.M.—Dr. P. W. Bryan: The Distribution of Houses in England and Wales as a Population Index (Lecture).

DECEMBER 31 TO JANUARY 7.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Wednesday, Dec. 31, at 3.—Sir Richard Gregory: The Worth of Science (Presidential Address).

FROEBEL SOCIETY AND JUNIOR SCHOOLS ASSOCIATION.

At 5.30.—J. Howard Whitehouse: Ideals and Methods in Education (Presidential Address).

BRITISH PSYCHOLOGICAL SOCIETY (EDUCATION SECTION).

At 5.30.—Prof. T. H. Pear: Learning how to Study (Lecture).

NEW EDUCATION FELLOWSHIP.

Thursday, Jan. 1, at 5.—Discussion on The Efficiency of the First School Examinations and their Relation to Matriculation.

SCHOOL NATURE STUDY UNION.

At 3.—Sir J. Arthur Thomson: The Beauty and Wonder of the World (Lecture).

UNIVERSITY OF LONDON ANIMAL WELFARE SOCIETY.

At 5.—Mrs. Susan Isaacs, Miss S. M. Wortman, O. H. Latter, and Capt. C. W. Hume: Discussion on Humane Education in Schools.

DALTON ASSOCIATION.

Friday, Jan. 2, at 11.—G. W. Spriggs: Individual Work in Mathematics (Lecture).

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION.

At 2.—Dr. A. G. Maitland-Jones and others: Discussion on Hours of Sleep and the School Child in Day and Public Schools.

CHILD-STUDY SOCIETY.

At 5.30.—Prof. J. E. Marcault: What is Religious in the Child? (Lecture).

MODERN LANGUAGE ASSOCIATION.

Monday, Jan. 5, at 11 A.M.—Prof. E. W. Scripture and Prof. P. Menzrath: Discussion on Experimental Phonetics.

NATIONAL COLLEGE OF TEACHERS OF THE DEAF.

At 11 A.M.—Dr. J. Drever: The Educational Handicap of the Deaf from a Psychologist's Point of View (Lecture).

JOINT CONFERENCE.

At 5.—J. Fairgrieve, Lt.-Gen. Sir William Furse, Miss B. Hosgood, C. B. Thurston: The Teaching of Geography. Chairman: Sir Richard Gregory.

CENTRAL COUNCIL FOR SCHOOL BROADCASTING.

Tuesday, Jan. 6, at 11 A.M.—Prof. Winifred Cullis and others: The Teaching of Biology by Wireless (Lecture-Demonstration).

BRITISH SOCIAL HYGIENE COUNCIL.

At 5.—Dr. H. Crichton Miller: Marriage, Freedom, and Education (Lecture).

JANUARY 5 AND 6.

MATHEMATICAL ASSOCIATION (at London Day Training College).

Monday, Jan. 5, at 3.30.—Sir Arthur S. Eddington: The End of the World (from the standpoint of Mathematical Physics) (Presidential Address).

At 5.—Prof. A. R. Forsyth: Dimensions in Geometry.

Tuesday, Jan. 6, at 10 A.M.—A. Robson and others: Discussion on The Report on the Teaching of Mechanics in Schools.

At 11.30 A.M.—W. Hope Jones, Dr. F. J. W. Whipple, P. M. Marples, and others: Discussion on Gambling.

At 2.30.—Prof. J. E. A. Steggall: Faith and Reason in beginning the Calculus and Elsewhere.

At 3.45.—Prof. E. H. Neville: Limits in Geometry.

JANUARY 6 TO 9.

SCIENCE MASTERS' ASSOCIATION (at University, Birmingham).

Tuesday, Jan. 6, at 8.30 P.M.—Sir Charles Grant Robertson: Presidential Address.

Wednesday, Jan. 7, at 10.15 A.M.—J. Young: The Lunar Landscape (Lecture).

At 11.30 A.M.—Prof. W. N. Haworth: An Insight into Complex Molecular Structures (Lecture).

At 6.—Prof. Nash: The Work of the Physicist and Chemist in the Petroleum Industry (Lecture).

At 8.15.—The Lord Bishop of Birmingham: A Finite Universe? (Lecture).

Thursday, Jan. 8, 10 to 11.15 A.M.—F. Fairbrother and others: Discussion on General Science.

At 12.—Prof. K. N. Moss: Scholarships offered in Coal Mining and Metal Mining.

6 to 7.15.—Prof. F. W. Burstall: The Science Education of the Boy up to Eighteen Years of Age (Lecture).

At 8.30.—Meeting of S.M.A. with Representatives of the Commission on Educational and Cultural Films.

Friday, Jan. 9, at 10 A.M.—Prof. H. Munro Fox: Zoological Experiments for School Work.

EXHIBITION.

JANUARY 6 TO 8.

PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION OF ELECTRICAL, OPTICAL, AND OTHER PHYSICAL APPARATUS (at Imperial College of Science and Technology), at 3 to 6, and 7 to 10.

Wednesday, Jan. 7, at 8 P.M.—E. Lancaster-Jones: Searching for Minerals with Scientific Instruments (Lecture).

Thursday, Jan. 8, at 8 P.M.—Sir Gilbert Walker: Physics of Sport (Lecture).